AMENDMENTS TO THE DRAWINGS

Proposed drawing changes are shown on the attached annotated marked up drawings and are incorporated with the attached proposed replacement sheets of drawings.

Attachment: Replacement Sheet(s) – 16 sheets (Figures 1 - 7)
Annotated Sheet Showing Changes (Figures 1 -7)

REMARKS/ARGUMENTS

Reconsideration of this application is respectfully requested.

In response to the objection to claim 5 as being of improper dependent form, claim 5 has been amended above so as to put it in more traditional U.S. format. However, it is noted that this claim never has been a "dependent" claim because it does not refer back to any previous claim.

In response to the rejection of claims 1-14 under 35 U.S.C. §112, second paragraph, the claims have been amended above so as to obviate each of the Examiner's stated reasons for this rejection.

The rejection of claims 1-5, 8-9, 12 and 14 under 35 U.S.C. § 102 as allegedly anticipated by Brown CA '441 is respectfully traversed.

The present invention concerns network termination apparatus, which provides customer or subscribers' premises (a private domain controlled by the subscriber) a connection to the external telecommunications network (the public domain which is controlled by and the responsibility of, the network operator). As is well known from and implicit in the term "network termination," this refers to the demarcation point between the private and public domains. This would be basic to the skilled person in the art, which is why it is little discussed in the specification.

For the Examiner's convenience, a copy of a technical standards document (ND1602:2002/11) from the Network Interoperability Consultative Committee in London is attached.

It will be noted at footnote 8 on page 18 that a "Network Termination Point," is defined as "the legal demarcation between the network provider's cabling and the customer's in-house

wiring. On a telephone line this point often has a master socket or NTE ("Network Termination Equipment")."

A network operator is thus legally responsible for the performance of the link up to the point where the network ends or terminates (this typically being the last mile of the access network), which comprises the interface located within the socket hidden behind a spring-loaded cover (7) of prior art termination equipment NTE 5 in Figure 1. The interfacing component can be (just about) seen on the back view (9) of the NTE 5 box. The customer connects to the network by plugging into the socket (7) a conventional plug such as a RJ-11 or RJ-44 connector which is compatible with the socket. Such plugs and equipment lie beyond the network operator's domain or responsibility.

In order to meet its obligations, the network operator needs to be able to test and diagnose up to the termination point and the equipment thereat, which could be a routine check or in response to a specific fault.

The "wall plug" of applicant's Claim 1 explicitly includes such "termination means" which the skilled person would understand as referring to an element such as the interface sitting within socket (12) (e.g. Figure 4A) which represents the very edge and demarcation point of the external public network.

Two embodiments of applicant's invention are described: the first on page 5 line 11 to page 6 line 20, and the second on page 6 line 22 to page 10 line 28.

The first is a relatively slim tube or plug which can be retrofitted into a hole drilled using e.g. a DIY-standard drill as described on page 8 lines 11 and 12. At its simplest, this first embodiment comprises simply the termination interface to which point the network operator is obliged to test and no further.

The second embodiment is a slightly larger device which includes a hollow wall plug (101) which is sufficiently capacious within to accommodate an electronic module (22) (Figure 6D) which includes the terminating interface located in the socket (12). The electronics included within the body of this hollow wall plug advantageously allow for the termination point to take on additional ADSL and HPNA functionalities. It would be apparent to the skilled person that test and diagnostic components allowing e.g., testing of the line up to the point could be included within the hollow as well, either remotely from the exchange end of the line, or by an engineer at the site as stated on page 10 lines 27 of the specification.

Brown describes a multi-service floor outlet which, among other things, includes sockets for creating voice and data connections. The fireproof quality of the housing is evidently an important consideration, as this device is to be installed between floors in high-rise buildings, so that cables are routed through the ceiling space of the underlying room.

Independent claims 1 and 5 have been amended so as to make it clear that applicant is here claiming a network termination wall plug which includes termination means for terminating a telecommunications line connected to an external telecommunications network as well as connection means for receiving a connector of an interior customer telecommunications equipment (claim 1) and/or as having circumferential irregularities so as to be received within and frictionally engage a bore a in a wall, etc. (claim 5).

Clearly Brown's floor outlet does not provide a network termination wall plug. Indeed, Brown's floor outlet is described repeatedly in terms of its structure for preventing flame penetration between floors of a multi-floor building given the propensity of heat, smoke and flames to rise. It is unlikely that those having only ordinary skill in the art faced with the problem of devising a network termination wall plug for telecommunications lines and

telecommunications customer equipment would have found it obvious to consider Brown's floor outlet as a possible solution. The two structures are situated in considerably different positions within building structures and for substantially different purposes.

The rejection of claim 13 under 35 U.S.C. §103 as allegedly being made "obvious" based on Brown is also respectfully traversed--for reasons already noted with respect to parent claim 1.

The rejection of claims 6-7 and 10-11 under 35 U.S.C. § 103 as allegedly being made "obvious" based on Brown are also respectfully traversed.

The Examiner recognizes that Brown fails to teach a tapered body and snap-fitted connectors in the cavity of the body but alleges that those having ordinary skill in the art would have found such features to have been "obvious." However, given that the Brown teaching is limited explicitly to multi-service floor outlets in a multi-level building and not to a network termination wall plug for transitioning a telecommunications cable from outside the house structure through an exterior/interior wall structure to terminate with customer equipment, why would those having only ordinary skill in the art have decided to taper the outside of the Brown structure? The Examiner says that tapered surfaces would be used by those ordinarily skilled in the art for "smooth fitting." However, when one is talking about a telecommunications cable terminating wall plug that feeds through an exterior/interior wall structure, there are other reasons for tapering the exterior configuration of the structure. However, if one is to avoid improper use of hindsight, then there is nothing in Brown that would suggest or motivate the ordinarily skilled artisan to taper the outside walls.

KSR did not ignore the dangers of hindsight: "A factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant on ex post reasoning." *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S.___, 82 USPQ2d 1385, 1397 (2007).

Although the Court rejected the "[r]igid preventative rules," *id.*, that had been erected by the Federal Circuit, it did not enable the use of hindsight in determining obviousness.

The Examiner's attention is also drawn to new claims 16-30 which are directed to applicant's second embodiment wherein the hollow body also houses an electronic module. Clearly Brown does not teach or suggest the inclusion of an electronics module in the body of a wall plug suitable for terminating an external telecommunications network with an item of customer telecommunications equipment. Indeed, there would be little impetus for doing this within the context of Brown's substantially fireproof floor outlet.

New dependent claims 17-30 add yet further patentable distinction to this claimed invention.

Accordingly, this entire application is now believed to be in allowable condition and a formal notice to that effect is respectfully solicited.

Respectfully submitted,

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ND1602:2002/11

Specification of the Access Network Frequency Plan applicable to transmission systems used on the BT Access Network

Oftel Technical Requirement OTR004:2002 Issue 2

Network Interoperability Consultative Committee
Oftel
50 Ludgate Hill
London
EC4M 7JJ
UK

http://www.oftel.gov.uk/ind_groups/nicc/

Normative Information

If you have any comments concerning the accuracy of the contents of this document, please write to:

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Network Interoperability Consultative Committee,
Oftel,
50 Ludgate Hill,
London,
EC4M 7JJ

Contents

Foreword

This document has been produced by the NICC Task Group on Digital Subscriber Line (DSL) – Spectrum Management Plan. Network Operators, switch and terminal equipment manufacturers, test laboratories, DTI (CII and RA), and OFTEL participated in the Task Group.

This issue of the ANFP is a revision of ANFP, Issue 1.1 following unanimous agreement within the NICC DSL Task Group to incorporate:

- a new customer end category (called 'extra short') with masks that permit the use of 2.3 Mbit/s SDSL systems
- an alternative set of requirement for the voiceband frequencies that are particularly aimed at aiding demonstration of ANFP compliance for voiceband equipment.

This issue of the ANFP is backwards compatible with the previous issue of the ANFP i.e. any deployment that was compliant with the previous issue of the ANFP will be compliant with this issue.

1 Scope

This specification defines the Access Network Frequency Plan (ANFP) applicable to transmission systems to be used on the BT access network. It is applicable to the whole of the BT access network provided using unscreened twisted metallic pairs (e.g. it does not apply to the access network provided by optical fibre).

To ensure the prevention of undue interference between transmission systems used on different metallic pairs in the same access cable, transmission systems (whether provided by BT, OLO or customer) connected to metallic pairs of the BT access network need to conform to this specification.

This specification is applicable to all BT switched and leased line analogue services, and to OLOs using the BT access network as defined in condition 83 of the public telecommunications operator's license issued to BT [14].

The limits specified in the ANFP apply when measured according to the associated reference measurement technique given in Annex B.

This issue of this specification considers access to frequencies up to 1.1 MHz (e.g. for systems up to and including ADSL). The use of frequencies above 1.1 MHz is specified in the Trial ANFP applicable to transmission systems used on Sub-loops (ANFP-S) in the BT Access Network [18]. It is the intention of the DSL Task Group that when the ANFP-S is updated to full issue, it will be incorporated into this document.

It is recognised that a customer's installation may comprise wiring and a number of items of customer premises equipment (CPE). Further, there may be other items of equipment between the customer's installation and the metallic pair (i.e. on the network side of the NTP), e.g. filters or active line termination equipment. The limits in this ANFP apply at the interface to the metallic pair of the BT access cable.

Where a customer's installation causes, or can reasonably be foreseen to cause, harmful interference to transmission systems used on different metallic pairs in the same [or other] access cable[s], BT may require that the interference be prevented, for instance by means of mitigation measures (e.g. by the addition of a filter), or by requesting authorisation for disconnection under Article 7.4 of the RE&TTE directive [7] or other relevant powers.

Note 1: Although, from a regulatory perspective, it is not a mandatory requirement for customer premises equipment (CPE) to conform to this ANFP, since this would be contrary to the RE&TTE directive [7], it is strongly recommended that CPE does conform to this ANFP.

Note 2: This specification only considers the limits relevant to control of interference between transmission systems on different lines. There may be other limits also applicable, and conformance to this specification does not necessarily satisfy those limits. Such other limits may include, for example, safety limits on line voltages (see EN 60950 [21]), RFI balance requirements, and line sharing limits.

2 ANFP Construction

The ANFP was developed as a result of the proposals defined in the OFTEL Access to Bandwidth statement (November 1999) [9]. The construction of the ANFP was based on the criteria:

- set out in the OFTEL Access to Bandwidth statement
- defined by the DSL Task Group.

These criteria are documented in the ANFP History (see Annex E). This ANFP aligns with the OFTEL ANFP Determination (September 2000) [13] and includes unanimous agreements reached in the DSL Task Group since the date of that determination.

In deciding the criteria to be used and the method of construction for the ANFP, the DSL Task Group took account of the work on this subject being undertaken in ATIS T1E1 [12] and ETSI TM6 [11].

The ANFP has been constructed using the following method:

- the management of the ANFP will be by hard Power Spectrum Density (PSD) masks[1] [8].
- each interface giving access into the cable plant will have a PSD mask defined for it. Interfaces at different locations may have different masks.
- the mask will apply to any equipment connected at the location, irrespective of modem type[2].
- the mask will define the limits for power transmitted (or leaked) into the cable plant.
- at each frequency, the PSD of the transmitter must be at or lower than the permitted PSD mask.

The permitted PSD masks are produced as follows:

- The systems already deployed in significant volumes are identified[3]. These are taken as the existing noise environment (any transmission system will be permitted to be used on the BT access network provided that it conforms to the ANFP masks).
- A PSD mask is produced for each transmitter of each identified system.
- Locations are categorised according to which identified system transmitters may have been installed there.
- For each location category the permitted PSD mask is, at each frequency independently, the maximum of the masks for those transmitters which may have been installed there.

This method of construction is consistent with the work so far undertaken in ETSI TM6. It derives from the fact that the identified systems in the network have been deployed such that they will operate reliably in the presence of the crosstalk from other identified systems.

Any increase in the level of pollution that is permitted will directly result in decreased margin of performance in already deployed systems. Any substantial increase would cause these systems to fail.

It should be noted that the ANFP is constructed with masks that are more realistic than those in current equipment standards. The equipment standards typically have a generous margin between what a system is limited to and what a real system actually produces, so a good implementation passes the standard easily. However some real systems already deployed would fail if their neighbours were to fully exploit a mask based on the equipment standards' masks. It has been necessary to use masks from FSAN[4] for the identified systems' transmitters. However every effort has been made to enable the deployment of the maximum variety of future DSL systems where this can be done without impact to the identified systems.

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[1] It was recognised that defining the requirements and associated tests in terms of PSD masks was not necessarily appropriate for voiceband equipment, particularly existing voiceband equipment that had been subject to testing under the CPE approvals regime prior to the RE&TTE Directive. Hence this issue of the ANFP specifies an alternative set of requirements for the voiceband frequencies that may be used to demonstrate ANFP compliance.

[2] Strictly the ANFP is applied to the point of connection, so applies even in the absence of any equipment.

[3] The xDSL systems that have been taken into account in this ANFP specification are ISDN basic access, 2-pair and 3-pair 2 Mbit/s 2B1Q HDSL systems, and ADSL over POTS. All deployed as per BT's historical deployment rules. SDSL technology was also admitted, but limited to a selection of rates with minimal impact on the ANFP masks.

[4] Full Services Access Networks – a group of network operators and suppliers who co-operate in driving standards work towards specifying equipment that is usable by operators.

3 ANFP Specification

The ANFP is currently defined by a set of categories for access interfaces, each having a PSD, and by voiceband specifications based on published ETSI standards applicable to CPE.

For frequencies at and below 200 kHz, equipment compliant to this ANFP must either meet the requirements defined in section 3.1 or section 3.2. For frequencies above 200 kHz, the requirements of section 3.1 apply.
Note: equipment that has been approved under the UK terminal equipment approval regime that existed prior to the implementation of the RE&TTE Directive [7] is deemed to be compliant to this ANFP.

3.1 PSD Mask and Interface Categories

3.1.1 Interface Categories

Each interface is assigned to one of five categories, determined by its location. One category is for the interfaces in an exchange, the others are for customers at various distances from the exchange. The controlled interfaces are the MDF in the exchange and the NTP at the customer's premises.

The categorization of customers' locations is in terms of 'electrical distance' from the exchange, defined by loss values at 100kHz, for a nominal line to the exchange. The categories are defined in table 1 and illustrated in figure 1.

Category name	is applied to interfaces at these locations
down exch	the MDF of an exchange
up extra short	the customer NTP where electrical distance from the exchange is 21 dB or less
up short	the customer NTP where electrical distance is 26 dB or less but over 21 dB
up medium	the customer NTP where electrical distance is 29 dB or less but over 26 dB
up long	the customer NTP where electrical distance from the exchange is over 29 dB

Table 1 – ANFP Interface Category Definitions

The definition of 'short', 'medium' and 'long' is based on BT's historical deployment of HDSL. Note that despite the names it is the interfaces which are categorized, and that neighbouring line interfaces have the same limits irrespective of the electrical properties of their respective pairs[5]. Hence in general all interfaces sharing a given DP[6] will be categorized the same.

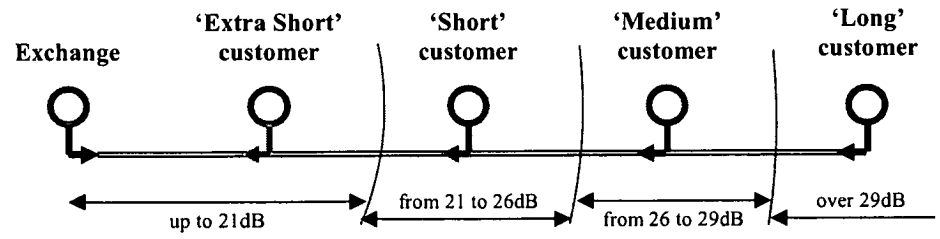


Figure 1 – The ANFP Interface Categories

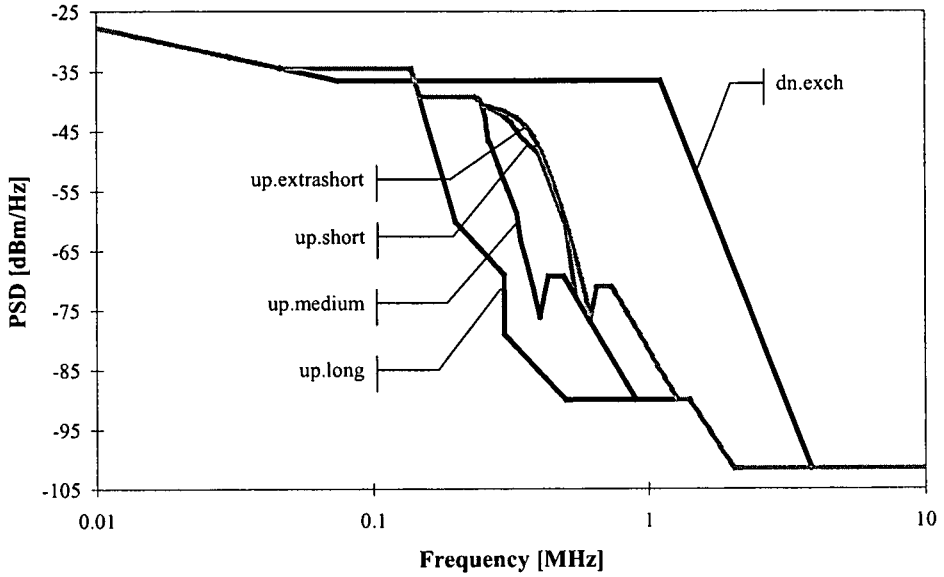
[5] because spectrum management is about limiting harm to neighbours, not directly about what a given line is capable of

[6] Distribution Point – the final flexibility point in the BT access network before the line reaches its customer.

3.1.2 PSD Masks

Each interface category has a mask defined for it, and which is given the same name. Mask 'down exch' is a downstream mask, for lines toward the customers. It is the only downstream mask currently defined. The other four masks are upstream masks, for lines toward the exchange.

The set of five permitted masks is specified by the data given in Annex A, which is definitive. Figure 2 illustrates this data. The data is also available in machine readable format [1].



Notes: All PSD masks are defined over the range 100 Hz to 30 MHz, although only a subset of this range is shown in the figure above.
Where the PSD masks overlap only one is shown.

Figure 2 – Permitted PSD Masks

3.2 Alternative Voiceband Specification

For frequencies at and below 200 kHz, compliance to this ANFP may be demonstrated by conformance to the requirements in this section as an alternative to meeting the requirements of section 3.1. The requirements are applicable at both the customer end (irrespective of category) and exchange end of an MPF.

Note: 1. The requirements in this section are drawn from ETSI voiceband CPE standards[7]. However, any type of equipment may use these requirements (and associated tests) instead of the requirements in section 3.1 to demonstrate compliance to this ANFP.

Equipment compliant to this ANFP shall meet the requirements of the following Clauses of TBR 21 [15] (Note 2):

- Clause 4.7.3.1 (Mean sending level);
- Clause 4.7.3.2 (Instantaneous voltage);

[7] Various technical standards have set voiceband limits for CPE but the most recent were TBR 21 [15], EN 301 437 [16], EG 201 121 [17] and TR 103 000-2-1 [19] all published by ETSI.

- Clause 4.7.3.3 (Sending level in a 10 Hz bandwidth) as modified by TR 103 000-2-1 [19] (See Notes 3 and 4);
- Clause 4.7.3.4 (Sending level above 4.3 kHz) as modified by TR 103 000-2-1 [19];
- Clause 4.8.2.2.1 (DTMF Absolute Sending Levels) (See Note 5).

Note 2. The intent of these requirements is to control the level of crosstalk. TBR21 deals with other aspects but only those requirements relating to the control of crosstalk have been included in this ANFP.

Note 3. The requirements of this clause below 100 Hz do not apply in this ANFP.

Note 4. As described in EN 301 437 Annex C, it is not necessary to test the requirements of this clause if the terminal is a voice terminal (e.g. has a handset) and requires voice stimulation to perform the test.

Note 5. Only applicable if the equipment has a DTMF sender.

Infrequent and short duration signals at levels higher that those specified in this section are permitted from equipment used for MPF maintenance or from equipment connected to the exchange end and used for management and maintenance of voiceband services (e.g. the howler signal – see BS6305 [20], Appendix C.4)

4 Key Features of the ANFP

The ANFP defined in this specification is able to fulfil the requirements for a spectral management plan as set out in BT licence condition 83 [14]. The ANFP controls the spectrum and power that can be launched into each of the Exchange end and the Customer premise end of the wire-pair. The limits vary with distance from the exchange, and a set of four categories is defined based on notional insertion loss at 100 kHz.

The ANFP does not preclude use of broadband equipment on any line, although serviceability on a line is subject to the electrical qualities of the line and the technical capability of the xDSL systems used. There will be some very long lines on which it will be difficult to give satisfactory service using xDSL. However, future advances in xDSL may enable even these lines to have substantially more capability than currently provided by voiceband modems.

The ANFP balances the need for provision of symmetric services to the business (and residential) sector against the desire for widespread deployment of ADSL to mass-market residential customers, enabling the Government's vision of Broadband Britain.

The ANFP has been made as simple as possible whilst still being fit for purpose. It does not place any special restrictions on wire-pair selection, and in principle allows for 100% cable fill. (While it is unlikely that BT's network would reach 100% xDSL fill, there are credible situations that give equivalent interference.) Adopting a policy of no additional special pair selection processes means that engineering costs are minimised.

The ANFP is technology neutral, and as such is as future proof as possible. The PSDs used in the ANFP are consistent with the levels used by internationally standardised xDSL systems. This minimises the risk of introduction of rogue xDSL systems with strong line spectra that may cause objectionable radiated emissions.

The use of SDSL systems (as defined in international standards) has been factored into the ANFP and will be permitted by the plan (the data rate that may be attempted by these systems will be dependent on the categorization of the customer's end).

The ANFP will support all voiceband equipment that was previously permitted to be connected to the BT access network prior to the development of the ANFP. This issue of the ANFP includes an alternative set of requirements and test procedures for the voiceband frequencies that is specifically aimed at aiding determination of ANFP compliance of voiceband equipment.

For further information on the features of the ANFP and guidance on conformance to the ANFP, see the ANFP User Guide (Annex D)

5 Future Development

The change control process for this specification has been is given in Annex F.

The Task Group has developed a Trial ANFP for systems used on sub-loops (ANFP-S). This trial ANFP-S covers frequencies up to 30 MHz (i.e. including VDSL). Following completion of the international standards on VDSL it is planned to move this trial ANFP-S to full issue status and at the same time, merge it into this document, which will become BT ANFP Issue 3. This change is not expected to impact existing systems deployed in conformance to this issue of the ANFP.

6 Abbreviations

ADSL	Asymmetric Digital Subscriber Line
ANFP	Access Network Frequency Plan
ANFP-S	Access Network Frequency Plan for the Sub-loop
ANSI	American National Standards Institute Historical only, this organisation became ATIS
ATIS	Alliance for Telecommunications Industry Solutions 1200 G Street, NW, Suite 500 Washington, DC 20005 USA Tel +1 202-628-6380 Homepage http://www.atis.org>
BT	British Telecommunications plc *(bridged taps are not discussed in this document)*
CPE	Customer Premises Equipment
CSV	Comma Separated Variable - a file format based on plain text, readable by many common spreadsheet programs.
DP	Distribution Point – the final flexibility point in the BT access network before the line reaches its customer
DSL	Digital Subscriber Line - any of the modem technologies which send high speed data over metallic telephone pairs. A DSL line has a dedicated modem at each end of the physical wire pair; typically one of these is in the exchange
DSL TG	Digital Subscriber Line Task Group A subcommittee of PNO-IG
ETSI **ETSI TM6**	European Telecommunications Standards Institute TM6 is the working group on Access Networks Homepage: http://webapp.etsi.org/tbhomepage/TBDetails.asp?TB_ID=240

FSAN	Full Services Access Networks – a group of network operators and suppliers who co-operate in driving standards work towards specifying equipment that is usable by operators
G.shdsl	The form of SDSL standardized in the ITU SG15/Q4
HDSL	High bit rate Digital Subscriber Line
MDF	Main Distribution Frame
MPF	Metallic Path Facility - a term used in the BT Licence Conditions for the loop available to OLOs
NICC	Network Interoperability Consultative Committee - a committee of UK industry set up to advise OFTEL homepage: http://www.oftel.gov.uk/NICC/
OLO	Other Licensed Operator
NTP	Network Termination Point
PBLC	Partial Baseboard Leased Circuit This term was used in [9] but subsequently changed to Metallic Path Facility in the BT Licence Conditions
PNO-IG	Public Network Operators Interest Group - an interest group within NICC
POTS	Plain Ordinary Telephone Service - analogue voiceband telephony
PSD	Power Spectral Density - [8]
RFI	Radio Frequency Interference
RE&TTE	Radio Equipment and Telecommunications Terminal Equipment - [7]
RTTE	Radio and Telecommunications Terminal Equipment obsolete term, superseded by RE&TTE
SDSL	Symmetric Digital Subscriber Line - in this document 'SDSL' refers to that technology defined in ETSI TM6 [].
T1E1.4	T1E1.4 is the ATIS working group concerned with DSL Homepage: http://www.t1.org/t1e1/_e14home.htm
xDSL	any variant of DSL modem e.g. ADSL, HDSL, SDSL or VDSL
VDSL	Very high rate asymmetric Digital Subscriber Line

7 References

[0] "Specification of the Access Network Frequency Plan applicable to transmission systems used on the BT Access Network"
Oftel Technical Requirement OTR004:2002 Issue 2
available at URL http://www.oftel.gov.uk/ind_groups/nicc/Public/anfp_2.pdf

Self reference to give a holder of a paper copy access to the electronic version.

[1] ANFP PSD Mask Definitions
available at URL http://www.oftel.gov.uk/ind_groups/nicc/Public/anfp2msk.csv

This is a machine readable form of the table in Annex A. *Read Annex A to interpret this data. Any discrepancies are errors, in which case Annex A is definitive.*

[2] "Specification of the Access Network Frequency Plan applicable to transmission systems used on the BT Access Network"
Oftel Technical Requirement OTR004:2000 Issue 1 approved September 2000
available at http://www.oftel.gov.uk/ind_groups/nicc/Public/anfp_1.pdf

[3] "Essential requirements for terminal equipment intended for Connection to unstructured digital leased circuits of the public Telecommunications network using a CCITT Recommendation G.703 interface at a rate of 2048 kbit/s with a 75 Ω unbalanced presentation"
PD 7024: 1994
available from BSI, see URL http://www.bsi-global.com/

[4] EC, DIRECTORATE GENERAL XIII
"Informal Consolidated Text of the ONP Framework Directive"
10 June 1997
may be found at http://europa.eu.int/eur-lex/en/index.html

This is a preliminary version of the revised ONP framework directive, being directive 90/387/EC as amended by 97/51/EC.

Note: UK legislation in this area is currently in the process of being changed.

[5] ADLNB WG-2 (chairman C. P. Raymont)
"Guidance Notes on Measurement Uncertainty"
GN/WG2/1 issue 3 dated 19 March 1998

In the methods of [5] there is separation between requirements specification and the capabilities of any particular test house. ADLNB has recently been incorporated into a larger body, the "R&TTE Compliance Association"

[6] EC
"Directive 98/10/EC
of the European Parliament and of the Council of 26 February 1998
on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment "
Official Journal of the European Communities : OJ L 101/24 of 1.4.98

This is the Revised Voice Telephony Directive ("RVTD").
It may be found at http://europa.eu.int/eur-lex/en/index.html

Note: UK legislation in this area is currently in the process of being changed.

[7] The Crown
"The Radio Equipment and Telecommunications Terminal Equipment Regulations 2000"
UK Statutory Instrument 2000 No. 730
published on 13 March 2000
Authoritative version: ISBN 0 11 098835 3
Internet version: http://www.hmso.gov.uk/si/si2000/20000730.htm

This transposes the EC directive 99/5/EC into UK law. There is a discussion of the process at http://www.tapc.org.uk

[8] FSAN
"Interpretation of PSD for PSD masks"
TD 15 at the ETSI TM6 Meeting, Sophia Antipolis, 24-27 November, 1998

also presented to ATIS T1E1.4 as paper 98-327

[9] OFTEL
"Access to Bandwidth: Delivering Competition for the Information Age"
November 1999
may be downloaded as
http://www.oftel.gov.uk/publications/1999/competition/a2b1199.htm

[10] "General requirements for the competence of testing and calibration laboratories"
ISO/IEC 17025: 1999

[11] ETSI TM6
"Part 1 : Definitions and Signals Library"
Permanent Document TM6(99)07

This is the first product of the ETSI TM6 Spectral Management project

[12] ATIS T1E1.4
"Spectrum Management For Loop Transmission Systems"
T1.417-2001
may be downloaded from https://www.atis.org/atis/docstore/index.asp

[13] OFTEL
"Access to Bandwidth: Determination on the Access Network Frequency Plan (ANFP) for BT's Metallic Access Network"
may be downloaded from
http://www.oftel.gov.uk/publications/broadband/llu/anfp1000.htm

[14] OFTEL
"REQUIREMENT TO PROVIDE ACCESS NETWORK FACILITIES"
April 2000
may be downloaded from
http://www.oftel.gov.uk/publications/broadband/llu/acnf0400.htm

This is condition 83 of the public telecommunications operator's license issued to BT by Oftel

[15] TBR 21
"Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling"
January 1998
may be downloaded from http://www.etsi.org/

[16] EN 301 437
"Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE supporting the voice telephony service in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling"
June 1999
may be downloaded from http://www.etsi.org/

[17] EG 201 121
"A guide to the application of TBR 21"
February 2000
may be downloaded from http://www.etsi.org/

[18] "Specification of the Trial Access Network Frequency Plan applicable to transmission systems used on Sub-loops in the BT Access Network"
October 2001
available at URL http://www.oftel.gov.uk/ind_groups/nicc/Public/specs/anfps_1.pdf

[19] TR 103 000-2-1
"Advisory Notes to Standards Harmonizing Terminal Interface; Generally applicable Advisory Notes; Modification to sending spectral density requirements"
February 2002
may be downloaded from http://www.etsi.org/

[20] BS6305:1992
"General requirements for apparatus for connection to public switched telephone networks run by certain public telecommunications operators"
1992
available from BSI – see http://www.bsi-global.com/

[21] EN 60950-1:2001
"Information Technology Equipment – Safety; General Requirements"
2001
available from BSI – see http://www.bsi-global.com/

[22] NICC
"Guidelines for any inter-network interference issues between DSL operators in the same access network"
Issue 2, March 2002
available at http://www.oftel.gov.uk/ind_groups/nicc/Public/guidelines/nicc02_037.doc

[23] NICC
"Guidelines for any external network interference issues to radio users due to radiated emissions from fixed public networks"
Issue 1, March 2002
available at http://www.oftel.gov.uk/ind_groups/nicc/Public/guidelines/nicc02_036.doc

[24] ETSI TS 101 524
"Symmetrical single pair high bitrate Digital Subscriber Line (SDSL)"
2003
may be downloaded from http://www.etsi.org/

8 Document History

Issue 1	First Issue, September 2000	First issue
Issue 1.1	Approved, November 2000.	Addition of ANFP User Guide
Issue 2	Approved 11 November 2002	Amended to include extra short category; added alternative requirements and tests for voiceband frequencies.

Annex A - ANFP PSD Mask Definitions

The masks are defined by the data given in this Annex. The tabulated data define the corners of each mask. Between the given corners the mask values are defined by interpolation (as a straight line on log frequency / linear dB axes). Frequency is in MHz; each mask's PSD is in dBm/Hz.

This data is also available in a machine readable format [1]. This version is made available to help prevent input errors when performing modelling evaluation. Note that the CSV file contains "a" for the blank fields (to be interpolated) in the table below. This has been done to increase compatibility with some applications which don't treat blank entries correctly.

frequency	dn.exch	up.extrashort	up.short	up.medium	up.long
0.000100	-24.24	-24.24	-24.24	-24.24	-24.24
0.004010	-24.94	-24.94	-24.94	-24.94	-24.94
0.006058	-25.66	-25.66	-25.66	-25.66	-25.66
0.007177	-26.23	-26.23	-26.23	-26.23	-26.23
0.029549					-32.46
0.029769	-32.48	-32.48	-32.48	-32.48	
0.030000	-32.50	-32.50	-32.50	-32.50	-32.50
0.030145	-32.54	-32.54	-32.54	-32.54	
0.030286					-32.57
0.046922					-34.50
0.047135		-34.50	-34.50	-34.50	
0.074273	-36.50				
0.138000		-34.50	-34.50	-34.50	-34.50
0.145222		-38.04	-38.04		
0.147650				-39.19	
0.147654		-39.16	-39.16		
0.155286		-39.19	-39.19		
0.199724					-60.16
0.235084		-39.20	-39.20	-39.20	
0.241968		-39.52	-39.52		
0.246148		-39.96	-39.96	-39.96	
0.250067		-40.69	-40.75	-40.77	
0.256270				-42.68	
0.260179		-40.82			
0.262990				-46.67	
0.265315			-41.08		
0.266667				-46.94	
0.267397			-41.14		
0.292485			-42.05		
0.295483			-42.18		
0.300000					-69.00
0.300129		-41.61			
0.301000					-79.00
0.318586			-43.54		
0.332369		-42.65			
0.333333				-58.74	
0.336700			-45.12		
0.342917			-45.68		
0.344100				-63.23	
0.344352			-45.84		
0.358742				-66.25	

frequency	dn.exch	up.extrashort	up.short	up.medium	up.long
0.359870		-44.08			
0.382919				-71.41	
0.385485		-46.06			
0.400000			-48.70		
0.404317				-76.17	
0.412200		-48.74			
0.433333				-69.24	
0.440882		-52.16			
0.475149		-56.61			
0.492000				-69.24	
0.500000			-60.50		-90.00
0.513550		-61.76			
0.534365			-69.89		
0.545577			-72.81		
0.553011		-67.12			
0.590281		-72.29			
0.613095			-76.84		
0.613196		-75.62			
0.624021		-75.08			
0.650000		-71.00	-71.00		
0.735000		-71.00	-71.00		
0.897244				-90.00	
1.104000	-36.50				
1.268950		-90.00	-90.00		
1.400000		-90.00	-90.00	-90.00	-90.00
2.022220		-101.56	-101.56		
2.022420				-101.56	
2.022740					-101.56
3.863590	-101.56				
30.000000	-101.55	-101.55	-101.55	-101.55	-101.55

Annex B - ANFP Laboratory Test Specification

Contents

B.1 Scope

This test specification defines tests to be used in a laboratory environment to determine conformance of telecommunications equipment to the requirements specified in the main body of the ANFP.

The tests here only relate to the requirements of the ANFP. Other limits, for example those related to safety, line balance, and interactions between systems on the same pair are out of scope.

Note 1: As stated in the scope of this ANFP, the ANFP specification considers use of frequencies up to 1.1 MHz (e.g. for systems up to and including ADSL). The use of frequencies above 1.1 MHz is specified in the Trial ANFP applicable to transmission systems used on Sub-loops in the BT Access Network [18]. This Test Specification only covers the requirements in this issue of the ANFP.

Note 2: This test specification is for use in a laboratory environment only.

Note 3: Strictly the ANFP specifies limits at the ports of the access network, not for individual equipment per se. This specification is to verify that when deployed equipment would not violate the ANFP.

Note 4: Section B.5 of this document is based on the equivalent specification contained in the ATIS standard "Spectrum Management For Loop Transmission Systems" [12]. The use and reproduction of extracts from that standard is provided with kind permission of ATIS (Alliance for Telecommunications Industry Solutions).

B.2 Reference Model

The ANFP limits the power that may be injected into a metallic pair in the BT access network at two interfaces, the NTP[8] at the customer premises, and the MDF[9] at the exchange.

In the case of Local Loop Unbundling, there is a third interface, the HDF[10]. Managing crosstalk interference in the cabling between the HDF and the MDF is the responsibility of the network operator(s) using that cabling. The ANFP is applied at the MDF.

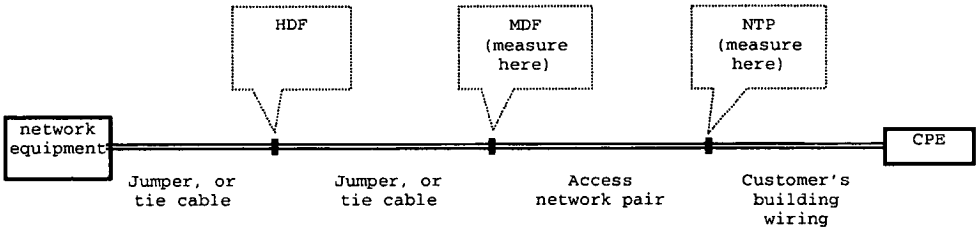


Figure B.1 : Network Interfaces to which the ANFP applies

B.3 Test Configuration

The equipment under test ("EUT") will comprise the end equipment, any ancillaries which are always present[11], and a load to represent the access network.

The equipment at each end is tested independently.

Equipment will be tested in all modes which the operator proposes to use. Other modes, perhaps provided for use in other countries, need not be tested.

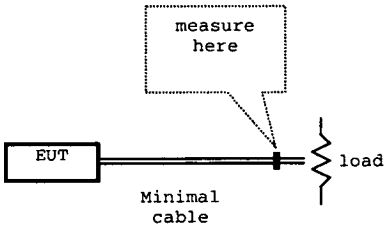


Figure B.2 : Test configuration

[8] "Network Termination Point", is the legal demarcation between the network provider's cabling and the customer's in-house wiring. On a telephone line this point often has a master socket or NTE ("Network Termination Equipment").

[9] "Main Distribution Frame", is the equipment which terminates the access network cables.

[10] "Handover Distribution Frame", is the equipment which terminates the tie cables.

[11] For example splitter filters, and connecting leads which are part of the kit supplied with the end equipment

The limits applicable to each end vary depending where the end is. For exchange end equipment there is one set of limits. For customer end equipment there are four, for locations at different distances from the exchange. An end equipment shall be tested against all the limits applicable to those places where it is proposed to be deployed.

B.4 Measurement Conditions

The prospective operator shall declare his deployment intentions for the equipment under test. This determines which modes the equipment is tested in, and which ANFP mask(s) it is tested against.

The measurement conditions below are derived from ISO/IEC 17025 [10], "Guidance Notes on Measurement Uncertainty" [5], and PD 7024 [3]

B.4.1 Estimation of uncertainty of measurement

A laboratory or facility performing testing shall have and shall apply procedures for estimating uncertainty of measurement.

When estimating the uncertainty of measurement, all uncertainty components which are of importance in a given situation shall be taken into account using appropriate methods of analysis.

The test report or compliance statement shall include the uncertainty of measurement.

Note: 1 It is recommended that measurement uncertainty is calculated as defined in [5]

Note: 2 Sources contributing to uncertainty include, but are not necessarily limited to, the reference standards and reference materials used, methods and equipment used, properties and condition of the item being tested.

B.4.2 Compliance

Compliance to the requirements of this standard shall be reported on the shared risk principle as specified in [5] figures 1 to 3.

Compliance to these requirements shall be determined either by use of the test methods defined within this standard or by use of test methods and results obtained from other standards accompanied with a technical justification detailing how such results demonstrate compliance to this standard.

Note: Since the requirements of this standard are derived from a number of technology specific standards in many cases it will be sufficient to test equipment to the specific design standard for their technology , and make a compliance statement to this standard following technical review of the results. The technical review should not be omitted as some options of specific technologies are excluded from these requirements and would present non-compliant results to this standard.

B.4.3 Calibration of test equipment

Equipment and its software used for testing shall be capable of achieving the accuracy required. Calibration programs shall be established for values of the instruments where these properties have a significant effect on the result

The equipment shall be calibrated to provide a 95% confidence level in the accuracy of the results.

B.4.4 General Conditions for Test

If the supplier has specified a temperature range within which the TE will be operational, the testing shall be performed within this range. The testing shall be performed within the temperature range 15 °C to 25 °C, if consistent with the temperature range declared by the supplier.

If the supplier has specified a humidity range within which the TE will be operational, the testing shall be performed within this range. The testing shall be performed within the humidity range 45% to 75%, if consistent with the humidity range declared by the supplier.

For equipment that is directly powered from the mains supply all tests shall be carried out within ±5% of the normal operating voltage.

If the equipment is powered by other means and those means are not supplied as part of the equipment, (e.g. batteries, stabilized AC supplies, DC) all tests shall be carried out within the power supply limit declared by the supplier.

If the power supply is AC the tests shall be conducted within ±4% of the stated frequency as declared by the supplier.

B.4.5 Independence of polarity

The equipment shall conform independent of the polarity of the pair it uses. For a line powered EUT the tests shall be carried out twice, once with each polarity of connection of the power supply.

B.5 PSD Conformance testing methodology

The section specifies the conformance testing methodology to be used to demonstrate compliance to the requirements defined in section 3.1. The conformance testing methodology in this clause is derived from "Spectrum Management For Loop Transmission Systems" [12]. It shall be used to determine compliance with the signal power limitations requirements in the ANFP.

Note: Where this ANFP makes no requirements (e.g. longitudinal output, nonstationary signals), this annex specifies no tests.

B.5.1 PSD measurement procedure

The limits applicable to a particular end equipment are discussed above, in section B.2.

B.5.1.1 Test circuit for PSD measurement

A test set-up as pictorially shown in figure B.3 shall be used for measuring PSD. Examples of specific embodiments of this test set-up are shown in figures B.4 and B.5. The difference between figures B.4 and B.5 is the input impedance of the instrument to be connected to V_{out}; figure B.4 assumes a high-impedance port, figure B.5 assumes a 50 Ω port (typical for a spectrum analyzer). The PSD may be tested while line powered or locally powered as required by the intended application of the EUT.

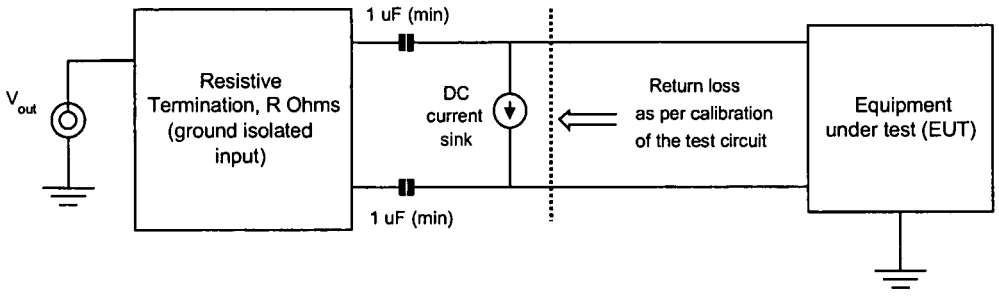


Figure B.3 - PSD measurement set-up

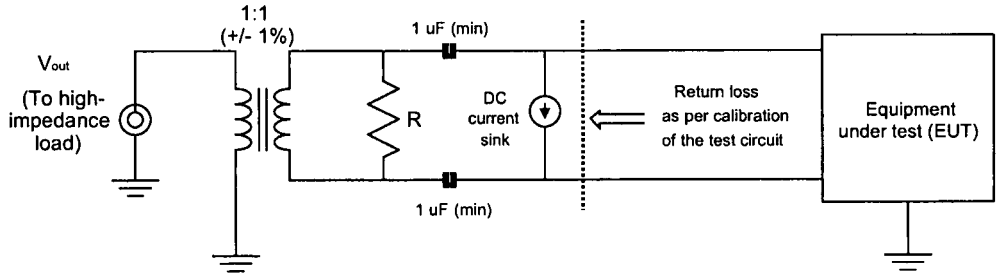


Figure B.4 - Example PSD measurement set-up for high impedance instrument

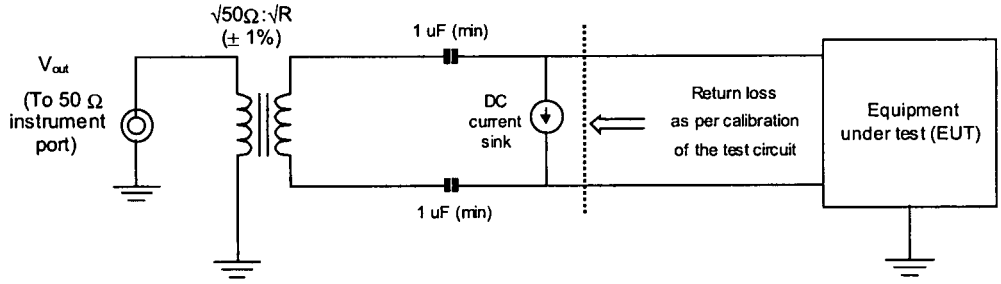


Figure B.5 - Example PSD measurement set-up for 50 ohm instrument

If the EUT neither sources nor sinks power the blocking capacitors may be omitted, as may the current sink. If present the capacitors shall be matched in value to within 1%.

If the EUT is line powered then the test circuit shall contain provisions for DC power feed, instead of the current sink.

For line powered applications, if the EUT is a TU-C the test shall be performed with the line power supply activated and an appropriate DC current sink (with high AC impedance) attached to the test circuit. If the EUT is a TU-R the test shall be performed with power (DC voltage) applied at the line interface by an external voltage source feeding through an AC blocking impedance. Note that the DC current source/sink must present high impedance (at signal frequencies) to common ground. The test circuit contains provisions for transformer isolation for the measurement instrumentation. Transformer isolation of the instrumentation input prevents measurement errors from unintentional circuit paths through the common ground of the instrumentation and the EUT power feed circuitry. When the termination impedance of the test circuit seen by the EUT output meets the calibration requirements defined in B.4.3 the test circuit will not introduce more than ± 0.25 dB error with respect to a perfect test load of exactly the specified resistance.

If the EUT is supplied with a voiceband splitter filter[12] then the tests shall be carried out with the splitter in circuit but with no voiceband signal applied. Where the splitter has a connector for the voiceband connection, this shall be open circuit during tests. Where voiceband equipment is integrated with the splitter this equipment shall be quiescent during tests.

The EUT shall be measured by equipment that is not synchronous with the transmitted symbols of the EUT, and there shall be no synchronization between the measurement equipment and the EUT. This is to avoid any cyclo-stationarity effects causing a misleading measurement.

B.5.1.2 Calibration of the test circuit and termination impedance

The nominal termination impedance of the test circuit as seen by the EUT output shall be resistive with a resistance of R between 100 Ω and 135 Ω. If the EUT has been designed to a published standard then the resistive impedance specified in that standard shall be used (providing it is between 100 Ω and 135 Ω). The minimum return loss with respect to the termination impedance R shall be 35 dB from 10 kHz to 2 MHz with a reduction of 20 dB/decade below and above these corner frequencies.

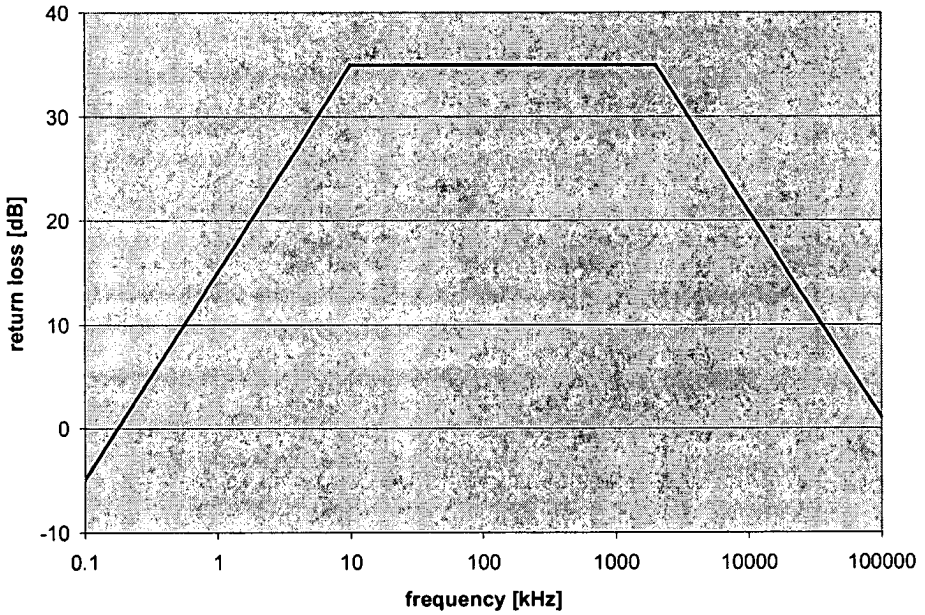


Figure B.6 – Return loss mask

Figure B.6 shows the return loss mask. The test circuit must exhibit this loss or higher at all frequencies.

Note 1: No passive circuit can exhibit a negative return loss, so calibration has implied limits on the frequency band to be measured over.

Note 2: 35 dB return loss will allow ±0.20 dB measurement error with respect to the nominal termination impedance value, R.

[12] e.g. to allow DSL and ordinary telephony to share the line

B.5.1.3 Operation of the EUT

The EUT shall be tested while it transmits maximum power and maximum PSD levels at all measured frequencies, which it can transmit data when deployed. The EUT shall have power cutback or boost configured to match the proposed deployment. The EUT shall be tested under steady state conditions, after all start-up and initialization procedures have been completed and while the EUT is transmitting data. To ensure that the EUT is in a steady-state condition, while undergoing test the EUT shall not have measured total average powers in distinct 1.25 millisecond time intervals that differ by more than 8 dB. The EUT input shall consist of a pseudo-random uniformly distributed data sequence, and the EUT output shall be a fully modulated transmit signal with all overhead, framing, coding, scrambling, modulation, filtering and all other operations performed on the data stream that the modem would normally perform while transmitting data.

Note: Although specific measurements of average power and PSD during start-up and other non-data transmission phases are not provided, a EUT that transmits inordinately high power or PSD levels during these phases may be considered to be in non-compliance with this standard.

B.5.1.4 Power spectral density (PSD) measurement procedure

B.5.1.4.1 PSD resolution bandwidth

The nominal frequency of a measurement will be the centre frequency of its resolution bandwidth. Instrument RBW shall be 10 kHz. Measurements will be at integer multiples of 10 kHz, starting at 10 kHz, so the lowest frequency measurement will be nominally 10 kHz and actually a window from 5 kHz to 15 kHz.

Inside the signal bands the measured values for each 10 kHz band shall be compared against the masks individually. Outside the signal bands the measured values will be averaged in overlapping groups of 100 10 kHz bands, to produce the effect of a 1 MHz RBW sliding window; the averaged values will be compared against the masks.

The mask value to be compared against shall be the maximum value the mask takes within the effective window. (Typically the first few steps of the 1 MHz sliding window will be compared against substantially higher values than the mask at the nominal centre frequency would suggest).

For the ANFP masks this means:

Table B.1 - Resolution bandwidth for measuring against the.down exch mask

Frequency Band	Resolution Bandwidth
100 Hz to 5 kHz	100 Hz
5 kHz to 3095 kHz	10 kHz
3095 kHz to 30005 kHz	1 MHz

Table B.2 - Resolution bandwidth for measuring against the up.extrashort and up.short masks

Frequency Band	Resolution Bandwidth
100 Hz to 5 kHz	100 Hz
5 kHz to 1265 kHz	10 kHz
1265 kHz to 30005 kHz	1 MHz

Table B.3 - Resolution bandwidth for measuring against the up.medium mask

Frequency Band	Resolution Bandwidth
100 Hz to 5 kHz	100 Hz
5 kHz to 895 kHz	10 kHz
895 kHz to 30005 kHz	1 MHz

Table B.4 - Resolution bandwidth for measuring against the up.long mask

Frequency Band	Resolution Bandwidth
100 Hz to 5 kHz	100 Hz
5 kHz to 505 kHz	10 kHz
505 kHz to 30005 kHz	1 MHz

In the low frequency band the PSD of an EUT shall be recorded with a frequency spacing equal to 100 Hz. In the two highest frequency bands the PSD of an EUT shall be recorded with frequency spacing equal to 10 kHz.

B.5.1.4.2 PSD Integration Time

Measurements shall be averaged over a sufficiently long time that the contribution to measurement uncertainty shall be no worse than 0.1 dB with 95% confidence. (For some spectrum analysers this will imply limits on video bandwidth and sweep time).

B.6 Voiceband Conformance testing methodology

The section specifies the conformance testing methodology to be used to demonstrate compliance to the alternative voiceband frequency requirements defined in section 3.2.

Conformance to the requirements specified in section 3.2 shall be demonstrated by using the following tests specified in TBR 21 [15]. The test methodology specified in TBR21 shall be used for non-voice stimulated terminals and the test methodology specified in Advisory Note AN 13R01 given in E.G. 201 121 [17] for voice stimulated terminals.

- Clause A.4.7.3.1 (Mean sending level);
- Clause A.4.7.3.2 (Instantaneous voltage);

- Clause A.4.7.3.3 (Sending level in a 10 Hz bandwidth) (Note 1);
- Clause A.4.7.3.4 (Sending level above 4.3 kHz)
- Clause A.4.8.2.2 (Signalling Levels) (Note 2).

Note 1. As described in EN 301 437 Annex C, it is not necessary to test the requirements of this clause if the terminal is a voice terminal (e.g. has a handset) and requires voice stimulation to perform the test.

Note 2. Only applicable if the equipment has a DTMF sender.

B.A Informative Appendix : Nonstationary Signals

This appendix concerns equipment which only transmits power intermittently – typically when there is data to send. The significant impact of such signals is due to their power when transmitting, not an average over all time.

It is technically difficult to specify how to measure intermittent signals, unless the equipment has a continuous signal test mode (in which case it may be sufficient to conduct tests in that mode, as for normal equipment). Furthermore, at time of writing there is little practical interest in deploying such equipment under the ANFP. Therefore a normative laboratory test specification is not provided.

Note: The ATIS Spectrum Management specification [12] does specify some tests for such signals, in its section 6.4 "Short-term stationary conformance criteria".

Annex C - ANFP Field Test Specification

Not defined.

The NICC DSL Task Group studied this subject and recognised the potential value that such a specification would have particularly in resolving inter-network (i.e. crosstalk) interference complaints. However, the Task Group studies identified the complexity and practical difficulties of producing an ANFP Field Test Specification that would fulfil the required objectives. This, together with lack of resource, has resulted in work on this subject being halted.

In order to help resolve any inter-network interference complaint, the Task Group have produced Guidelines on the Inter-network Interference Management [22]. In addition, recognising the potential for interference to external systems (e.g. radio) due to unintentional radiation of signals from MPFs supporting xDSL systems, the DSL Task Group has produced Guidelines on External Interference Management [23].

Annex D - ANFP User Guide

Contents

D.1 Introduction

This user guide outlines the industry agreements reached to manage the connection of equipment to the BT metallic access cables as part of the operational processes for Local Loop Unbundling in the UK.

D.1.1 Scope & Precedence

This User Guide is provided for information only. Every effort has been made to ensure consistency between this User Guide and other documentation produced by the NICC DSL Task Group and of the OPF Option 2 Implementation Group. However, in the event of any inconsistency or potential different interpretation, the words of the ANFP and the Access Network Facilities Service Contract form the normative text.

D.2 The ANFP for the UK

D.2.1 Line Categorisation

The ANFP defines different PSD masks for the customer end depending on distance from the exchange - primarily the electrical line length but also taking account the categorisation of other lines terminating at the same DP (Distribution Point).

This classification into extra short, short, medium and long is applied to all existing BT line ends based on an estimate of the insertion loss of a line to the exchange. New BT lines will be classified upon completion of their installation. Once the classification has been undertaken, the classification for a given end is fixed and will only change if that line (or the lines terminating on the same DP) is subject to a significant engineering modification (e.g. re-routeing due to a road development scheme) or to an ANFP category check process that results in a change in the category.

Like all other lines, the classification allocated to private circuits would be fixed and would only change if the lines forming that private circuit were subject to significant engineering modification.

D.2.2 How the various classes of DSL may fit the ANFP

In order to maximise the usefulness of the access network, based on the technologies in use or under consideration, four customer end categories have been agreed: 'extra short', 'short', 'medium' and 'long'. To a first approximation the end categories are indeed distinguished by loop length, but there are other determining factors. Therefore these line categories should be considered as labels rather than loop length values.

Within these definitions table D.1 names those standardised systems which were used in the construction of the ANFP, and which are intended to be admitted by design[13]. NB we assume here that the line under discussion is a normal line between customer premises and exchange.

Table D.1 – Designed-in systems

Extra Short Line	Short Line	Medium Line	Long Line
POTS	POTS	POTS	POTS
ISDN basic rate access	ISDN basic rate access	ISDN basic rate access	ISDN basic rate access
ADSL over POTS	ADSL over POTS	ADSL over POTS	ADSL over POTS
SDSL (773.34 kBaud)	SDSL (685.34 kBaud)	SDSL (501.67 kBaud)	SDSL (261.34 kBaud)
HDSL(2 pair E1) – 2B1Q	HDSL(2 pair E1) – 2B1Q	HDSL(3 pair E1) – 2B1Q	
HDSL (2 pair E1 - 1168 kbit/s) - CAP	HDSL (2 pair E1 - 1168 kbit/s) - CAP	HDSL (2 Pair E1 - 1168 kbit/s) - CAP	

Note: SDSL line rate is cited in kBaud because this is the aspect of line rate which concerns the ANFP[14].

[13] this is a statement of intent, for information. The definitive ANFP is annex A

The ANFP does not exclude specific systems; it excludes by implication : one may not install a system which does not conform to the masks at each of its ends. For example the issue 2 ANFP would exclude the following standardised systems[15] from use on *any* BT access network line ('extra short', 'short', 'medium' or 'long'):

- A 1-pair 2.3 Mbit/s HDSL system using 2B1Q or CAP
- ADSL over ISDN
- Reverse ADSL (i.e. with the high bandwidth implemented in the customer to exchange direction). This means that ADSL is precluded from use on private circuits.

D.3 Ensuring equipment conforms to the ANFP

To successfully manage crosstalk interference on the BT metallic access network, all equipment connected to the BT metallic access network needs to comply with the ANFP. Hence this includes:

- BT equipment connected to the metallic access network
- network operator equipment connected to a Metallic Path Facility
- customer equipment connected to an analogue NTP that is either directly or indirectly connected to the BT metallic access network, to the extent that its behaviour is relevant to conditions present on the metallic access network itself.

The ANFP is currently enforced through the following measures.

D.3.1 Enforcement on Network Operators

The contract between BT and network operators for provision of Metallic Path Facility requires both parties to comply with the ANFP. Demonstration of compliance is via a system of self-declaration.

Note 1: A Test Specification (Annex B) has been defined to test telecommunications equipment for conformance to the ANFP. The contract between BT and network operators requires network operators to "..ensure that Compliant Equipment to be connected to the Metallic Path Facility is tested, using the Access Network Frequency Plan Test Specification for compliance to the Access Network Frequency Plan" However it is up to the network operator whether it undertakes conformance testing itself or requires the supplier or a third party to undertake it.

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[14] A user may be more interested in nett data rate; there is also a gross data rate, which includes the modem pair's own overheads. In the SDSL standard

gross data rate = nett + 8 kbit/s

and line baud rate = gross data rate ÷ 3

The rates used in the ANFP construction are

SDSL rates	Gross data rate	Symbol rate	Nett data rate
Minimum, all masks	64 kbit/s	21 1/3 kBaud	56 kbit/s
Maximum, 'long' mask	784 kbit/s	261 1/3 kBaud	776 kbit/s
Maximum, 'medium' mask	1505 kbit/s	501 2/3 kBaud	1497 kbit/s
Maximum, 'short' mask	2056 kbit/s	685 1/3 kBaud	2048 kbit/s
Maximum, 'extra short' mask	2320 kbit/s	773 1/3 kBaud	2312 kbit/s

[15] This list is of course not exhaustive ...

Whatever way conformance is demonstrated, the responsibility for the declaration and the correctness of that declaration resides with the network operator. In the event of a dispute on the conformance of a piece of telecommunications equipment, the Test Specification (Annex B) will be used.

Note 2: as NTEs for analogue circuits are typically transparent to the signals generated by customer equipment, a customer's equipment that is non-compliant to the ANFP may cause undue interference on the BT access network. It is the responsibility of the network operator providing service to that customer to resolve any interference issues caused by non-compliant customer equipment.

D.3.2 Enforcement on Customer Equipment

The essential requirements that customer equipment must meet before that equipment is allowed to be connected to any public network is defined in the UK implementation of RE&TTE directive [7]. For customer equipment to be connected to a public fixed network, the essential requirements are currently limited to safety and EMC.

The Revised Voice Telephony Directive (RVTD [6]) requires network operators[16] to maintain the integrity of their network. Further, RVTD Article 13(2b) requires network operators to declare the conditions under which access to the network will be restricted or removed in order to protect the integrity of the network. Whilst the RVTD specifically applies to fixed public networks supporting voice telephony, Article 3(2) of the revised ONP framework directive [4] makes the same requirements applicable to non-voice telephony networks.

Hence network operators employing MPFs should declare that conformance to the ANFP by customer's equipment is a requirement for network integrity and that access to the network may be restricted if ANFP conformance is not maintained. Such a declaration should be made in the network operator's interface specifications for the relevant services. Publication of these interface specifications is a requirement under Article 4(2) of the RE&TTE Directive.

D.3.3 Enforcement on Equipment installed prior to the publication of the ANFP

As indicated in section 3, the ANFP has been developed taking account of existing equipment that has been deployed in significant volume. There may exist equipment deployed in relatively low volumes that does not comply with the ANFP e.g. existing CPE equipment approved for connection to analogue baseband circuits (q.v. OFTEL ANFP Determination [13]). It is intended that the ANFP should not be retrospectively applied to such equipment and such equipment will be allowed to continue working provided it does not cause undue interference to other systems. If one of these pre-ANFP systems is found to cause excessive interference, the resolution of the interference problem will be handled on a case-by-case basis.

If in the future the ANFP is amended, resulting in equipment that would have been compliant under the superseded edition of the ANFP not being compliant with the amended version of the ANFP, then the handling of such equipment needs to be taken into account as part of the considerations concerning the amendment of the ANFP.

[16] this means all network operators, not just the network owner

D.4 Policing the ANFP

D.4.1 Why are policing measures needed?

It should be stressed that if the interference preventive measures (e.g. ANFP conformance verification prior to implementation as outlined in section D.3) are universally applied, then there should be relatively few instances of interference problems. However some are still anticipated, for example those due to:

- equipment faults resulting in abnormally high power to line
- nonconformant equipment, as discussed in section D.3.3
- unusually high crosstalk coupling from normal causes. The ANFP is based on a statistical model of the network and access transmission systems with a 99% probability that conforming systems will not cause interference.

Considering this last point, it is possible that interference could be experienced even where all systems on an access cable conform to the ANFP. Furthermore, as more xDSL systems are deployed the noise level in an access cable will increase with a possible consequential impact on the performance of those systems already deployed.

D.4.2 What is covered by the policing measures?

Interference may be either: -

- Between pairs within the access network cables
  This may not only be caused by other xDSL systems but could also be via ingress of radio interference or from other non-xDSL customer CPE connected to other pairs in the cable.
- From or to systems external to the cable.

The ANFP covers only the interference between pairs within a cable and hence the ANFP policing measures only cover such situations. EMC regulations and measures within the Wireless Telegraphy Act cover interference from or to systems outside the cable.

D.4.3 What type of policing measures is to be adopted?

The development of pro-active measures or detailed procedures and specifications, which would be used very infrequently, is seen to be potentially expensive and unnecessary. Particularly in the early deployment where it is expected that there will be low numbers of systems in particular cables in most cases.

It has therefore been decided that the "Policing System" should be consumer complaint driven supported by a set of guidelines. The results of managing the interference complaints will provide feedback on the guidelines and hence this is likely to be changed as a result of experience.

D.4.4 Interference Management Guidelines

The DSL Task Group has produced Guidelines on the steps that would normally be considered reasonable for an operator to take to try and resolve an interference complaint. Separate guidelines covering inter-network [22] and external [23] interference have been published.

For inter-network interference, the policy has been adopted to try to eliminate all outside causes of a reported problem before expensive investigation of the multiple systems within a cable is undertaken. That may of necessity involve a number of operators within an MDF site and could cause the interruption of service to a potentially large group of their customers.

More detail of these measures is given in the Inter-network Interference Guidelines [22] but this would involve for example: -

- Questioning the customer concerning what other equipment is connected to their line.
- Checking that the reduction in service reported by the customer is a valid complaint by :-
  - Reviewing against the deployment rules to check that they have been followed.
  - Checking that the performance achieved does fall short of that in the service level agreement. It is possible that higher rates than those guaranteed by the ANFP could be achieved when the cable was lightly loaded with xDSL traffic but that this reduces as more users are added.
- Changing the DSLAM and Customer modems
- Possibly checking the MFP for any significant change from its initial measured parameters

D.4.5 The need for co-operation

It has been recognised that policing the ANFP and finding problems will only work if there is co-operation and trust between the operators involved. This will also require the rapid exchange of information concerning the technical details of the services being passed on pairs within an affected cable where the initial investigations, outlined above, fail to find the source of the problem.

Specifically co-operation will be required to investigate periodic interference or events that occur at specific times.

D.5 Evolution of the ANFP

Any changes to the ANFP can adversely affect (e.g. in terms of reduced reach, reduced performance) the transmission systems permitted in the original plan. Such changes would impact on the business cases not only of the network operator(s) using those adversely affected systems but also of the users (e.g. ISPs, Customers) using those systems. Hence the mechanism for the control of changes to the ANFP needs to be pre-defined so that users can assess the risks associated with possible changes.

The agreed change control procedure for the ANFP can be found in Annex F.

Annex E – ANFP History & Background

Contents

E.1 Introduction

At the request of OFTEL, the Network Interoperability Consultative Committee (NICC) DSL Task Group was reconvened to address various technical aspects of local loop unbundling (LLU). This included the development of an Access Network Frequency Plan (ANFP) to control interference within the access network. The group started work in September 1999 and this issue of the ANFP covers phase 1 (up to 1.1 MHz). Section 5 of the ANFP describes the planned future developments.

E.2 The need for an Access Network Frequency Plan

In order to maximise the capability of the systems deployed over the metallic network the effects of their mutual interference must be minimised. Even in the case of a single operator network an overall cable management plan must be in place to achieve this objective. However where there are multiple operators over the same infrastructure, as in the case of an unbundled local loop access network such a plan is essential in order that:-

- Maximum benefits in terms of bandwidth and quality of service are obtained for the end user
- All operators can understand the limitations the network places on their service delivery capability.
- Installation is simplified by increasing the certainty of being able to deliver the required service
- Disputes may be minimised
- Disputes may be settled in a transparent way

E.3 The ANFP for the UK

E.3.1 ANFP, Issue 1

The ANFP, Issue 1 was developed as a result of the proposals defined in the OFTEL Access to Bandwidth statement (November 1999). The construction of the ANFP was based on the criteria:-

- set out in the OFTEL Access to Bandwidth statement (these are reproduced in section E.3.1.1)
- defined by the DSL Task Group (see section E.3.1.2).
- defined in the OFTEL determination on the ANFP [13]

In deciding the criteria to be used and the method of construction for the ANFP, the DSL Task Group took account of the work on this subject being undertaken in ATIS T1.E1 and ETSI TM6.

By consensus agreement, this issue of the ANFP includes an alternative set of requirements and associated tests for the voiceband frequencies that can be used to demonstrate compliance. These alternative requirements/tests are particularly relevant of voice terminal equipment and are based on existing ETSI voice telephony standards.

A non-exhaustive list of generic xDSL systems that are permitted by the ANFP (Issue 1.1) is given in table D.1 (part of the ANFP User Guide). This list is not definitive and is provided for guidance only.

E.3.1.1 OFTEL Statement

Extract from OFTEL's Access to Bandwidth Statement [9], concerning the requirements for the ANFP:

OFTEL's Spectral Management Plan Objectives

B31 OFTEL's high level objectives for the spectral management plan (SMP) are:

- High customer penetration
- Technology neutral
- Minimal management processes

B32 It is OFTEL's goal to ensure the availability of broadband access to the largest proportion of the UK population as possibly. Ideally this would be 100%, however as discussed in paragraph B23 this is unlikely to be achievable using only BT's copper access network, instead a trade-off between the quality of the PBLCs[17] and the potential penetration level is required. Based on consultations with various technical groups OFTEL considers that a customer penetration level of 80 - 85% should be used as the design objective for the SMP.

B33 To ensure that the SMP is flexible, non-restrictive and contains a degree of future proofing OFTEL believes that it should be defined in a technology neutral fashion. For this reason OFTEL would favour the use of power spectral density (PSD) masks to describe the signals that can be connected to the network at different locations. It is recognised that at the present time ADSL and HDSL are likely to be the main technologies deployed, indeed HDSL in two and three pair form is already widely deployed in the network. It is therefore considered that the PSD masks should allow for the deployment of these technologies.

[17] PBLC – Partial Baseband Leased Circuit. This term was subsequently changed to Metallic Path Facility in the BT Licence Conditions

B34 In order to minimise the management costs associated with option 2 and to ensure its timely introduction, OFTEL believes that the SMP should be produced in such a way as to avoid the need for complicated and restrictive management processes. To this end mix quotas for certain services within a binder group and binder group configuration control should be kept to a minimum and if possible avoided altogether.

E.3.1.2 The agreed approach to an ANFP for the UK

The following principles were agreed by the UK industry technical body as the basis for the management of DSL system deployment within a cable. The numbering does not represent any form of priority or hierarchy.

1. **No pair segregation management within the access cable**
   One approach to the problem of management of DSL system deployment, adopted by some countries, is to specify the numbers and types of system that may be deployed in a particular cable. Because crosstalk interference is principally only a major issue between adjacent pairs – (normally about 6/7 pairs) it could be possible to control these effects by careful allocation of the systems used on adjacent pairs. This possibility has been rejected for the UK because:-

   - Historically, a "random jointing" policy was adopted in the BT copper network.
     A typical cable is pulled into a duct in sections, and the sections later jointed. Random jointing means the relative positions of pairs are not maintained between sections. Hence adjacent pairs in one part of the cable may not be adjacent in another part of the cable. Pair segregation is not possible in the BT access network.
   - The implementation of such a management function would require an associated process to be developed which would be very complex, costly, time consuming and require nominated resources. Such a process would also have to take account of additions and alterations to both the transmission systems used on the cable and the cable itself.

2. **Any transmission system on any pair**
   The adoption of an Access Network Frequency Plan would allow any transmission system that conforms to the plan to be used on any pair in the access cable. This means that the ANFP would allow :-

   - any pair in an access cable to support any of the transmission systems allowed by the ANFP.
   - all pairs in the cable to support the same transmission system (i.e. 100% fill).

3. **ANFP will be under pre-defined change control**
   Any changes to an ANFP can adversely affect (e.g. in terms of reduced reach, reduced performance) the transmission systems permitted in the original ANFP. Such changes would impact on the business cases not only of the network operator(s) using those adversely affected systems but also of the users (e.g. ISPs, Customers) using those systems. Hence possible changes to the ANFP need to be taken into account in the risk assessment of any business case using the access network and such risks need to be quantifiable if the evolution of the access network is not to be stifled. Hence the mechanism for the control of changes to the ANFP needs to be pre-defined so that users of the ANFP can assess the risks associated with possible changes.
   A defined change control process is not a prerequisite for Issue 1 of the ANFP.

4. **Existing transmission systems in the BT access network should be included in Issue 1**
   Development of the ANFP for the BT Access Network in the unbundled local loop environment is not a 'green field' site. If existing customers are not to be adversely affected, it must take account of transmission systems that have already been implemented in significant quantities. That is not to say that there can't be changes in the future but these changes need to take place in a pre-defined manner governed by Principle 3 above.

5. **Technology Independent**
   Ideally the ANFP would be technology independent. Whilst this can be an objective, it is probably wishful thinking that the ANFP can be completely technology independent.

6. **Protection of working systems**
The principal objective of the plan is to limit the behaviour of a system to protect its neighbours. This is the reason for a plan aimed at limiting spectra, since that's all a victim system will perceive. So the technical objective is indifferent to the technology from which the noise came (modulation scheme etc just don't matter).
The objective of this principle is to ensure that a system permitted within the ANFP can operate with a predictable minimum level of performance and quality of service.

7. **Safety**
The ANFP must also protect human safety and the physical integrity of the wires. Such issues are generally covered by existing international standards and these standards need only to be referenced.

8. **ADSL over POTS is the chosen ADSL system**
There are two variants of ADSL systems, ADSL designed to work over POTS and ADSL designed to work over ISDN. These are spectrally incompatible. The ANFP will allow the deployment of ADSL over POTS at the expense of ADSL over ISDN. ***This means that ADSL over ISDN will not be allowed by the ANFP and customers with ISDN wanting to also have ADSL will need a second metallic pair.***

9. **ANFP Phased development**
Taking account of the complexity in developing and specifying an ANFP and the need to have an ANFP published in the timetable required by the OFTEL Access to Bandwidth requirements, the development of the ANFP will be split into 2 phases. ANFP, Issue 1 will cover frequencies up to 1.1 MHz (i.e. include ADSL but not VDSL) and the transmit power allowed above 1.1 MHz will be set very low in order to protect that frequency spectrum for future allocation. Subsequent issues of the ANFP will specify frequencies up to 30 MHz (i.e. include VDSL).

E.3.2 ANFP, Issue 2

The ANFP was amended to become Issue 2 as a result of agreement in the DSL Task Group on the following 2 items:

- **addition of extra short line category:** since the development of ANFP Issue 1 the international standards for SDSL equipment have been completed. A number of network operators were interested in offering 2 Mbit/s (E1) services encapsulated within ATM using SDSL on a single pair. This requires a SDSL line rate of 2.32 Mbit/s and the up-stream PSD of such a SDSL system would not be compliant with any of the existing up-stream (i.e. short, medium, or long) ANFP PSD masks. Hence it was agreed to introduce a new ANFP category, to be called 'extra short', with a mask that admits the 2.32 Mbit/s SDSL PSD up-stream[18]. The range for this category was set at 21 dB at 100 kHz since modelling studies showed that this allowed the maximum reach for 2.32 Mbit/s SDSL without having significant, negative impact on the performance of any other transmission system previously permitted under ANFP, Issue 1.

- **voiceband frequency requirements:** the ANFP, Issue 1 provided no test specification in Annex 2 for frequencies below 5 kHz. This was a deliberate decision at the time of publication (Nov. 2000) as the Task Group was unable to quickly produce a specification that could readily be applied to both DSL equipment and voiceband equipment (e.g. telephones). The DSL Task Group subsequently developed an alternative set of requirements and associated test specification that was aimed primarily at enabling voiceband equipment to demonstrate ANFP compliance. This alternative set of requirements was based on voiceband equipment ETSI standards. Care was taken to ensure that CPE which would have been allowed to be connected to the BT network under the terminal equipment approvals regime that existed prior to the RE&TTE Directive would meet the ANFP voiceband frequency requirements.

[18] the existing exch mask will already admit this PSD downstream.

In addition to the above principal changes, a number of other changes were included in the production of ANFP Issue 2. These were:

- **ANFP Field Test Specification (Annex 3):** ANFP, Issue 1 stated that this was being developed. The subsequent DSL Task Group studies identified the complexity and practical difficulties of producing an ANFP Field Test Specification that would fulfil the required objectives. This, together with lack of resource, has resulted in work on this subject being halted. The ANFP Issue 2 gives the current status and highlights the publication of Interference Management Guidelines.
- **ANFP User Guide (Annex 4):** changes associated with the introduction of the extra short line category and the publication of Interference Management Guidelines have been made.
- **ANFP Change Control Procedure (Annex 6):** the introduction of the new extra short line category was agreed on the basis that it did not significantly impact the performance of transmission systems permitted under ANFP Issue 1. However there is concern that if the ANFP is subject to multiple amendments each of which has small impact, the cumulative effect of the changes could have significant impact on the performance of systems permitted under previous issues of the ANFP. Hence it was agreed to amend the change control procedure to add an addition criteria that addressed the potential cumulative effect of multiple changes.

Annex F – ANFP Change Control Procedure

The following ANFP Change Control Procedure is agreed and adopted by the NICC DSL Task Group[19].

Recognising that:

a) the implementation of the ANFP limits the type of telecommunications system that can be connected to the BT Access Network and the location of that connection.

b) the implementation of the ANFP limits the noise experienced by systems connected to the BT Access Network.

c) the business plans of network operators, service providers and customers may be affected by changes to the ANFP. Hence the stability of the ANFP (i.e. minimum period that could exist before the ANFP could be changed to the detriment of an organisations or individuals plans) needs to be defined in order that commercial risks can be assessed and investment decisions taken.

d) multiple amendments to the ANFP will have a cumulative impact on existing systems, perhaps leading to significant degradation of service even if no individual amendment is significant

e) experience with the operation of the BT Access Network in a multi-operator environment may provide improved understanding of the complex crosstalk interaction between telecommunication systems operating on different metallic pairs within the BT Access Network. This improved understanding may result in the need to amend the ANFP.

the NICC DSL Task Group adopt the following change control procedure for the ANFP:

1. A proposal to amend the ANFP may be submitted at any time by any interested party. The proposal shall be submitted to OFTEL. It is recommended that OFTEL request the DSL Task Group to provide advice on the acceptability of the proposed amendment.
2. Any proposal to amend the ANFP should contain: -
   - an impact assessment statement on at least the telecommunication systems listed in table D.1 (part of the ANFP User Guide)
   - a proposed date for implementation.
3. The NICC DSL Task Group will adopt a proposed ANFP amendment if there is consensus agreement i.e. there is no sustained objection from any member of the Task Group. The Task Group will take into account:
   - not only the impact of the proposed amendment on the current issue of the ANFP but also the impact compared with Issue 1 of the ANFP [2].
   - the need to discourage changes that would be likely to further erode the cross-talk noise environment, and might lead to denial of service, loss of service, or reduction in service quality for existing services. In the case of a proposal for such a relaxation, it is recommended that full consideration be given to the public interest benefit of such a change.
   - the need to encourage changes that would improve the overall crosstalk noise environment in the long term, with the objective of increasing the ubiquity of broadband services

[19] The NICC DSL Task Group is not a permanent body and the Task Group will close once all the deliverables allocated to the group have been completed. The requirement to consider proposals to modify the ANFP may exist after the closure of the DSL Task Group. In this case, it is recommended that OFTEL ask an appropriate UK industry forum to consider the proposed amendment and that that UK industry forum adopts these change control procedures.

4. Any objection to a proposed amendment should be supported by technical data to support the reasons for the objection.
5. Where there is no consensus agreement, the proposed amendment shall be passed to OFTEL for determination.
6. Changes to this ANFP Change Control procedure shall be via consensus agreement in the NICC DSL Task Group. Failure to reach consensus agreement will result in the proposed ANFP Change Control amendment being passed to OFTEL for determination.

- End -

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Fig.1A
(Prior Art)

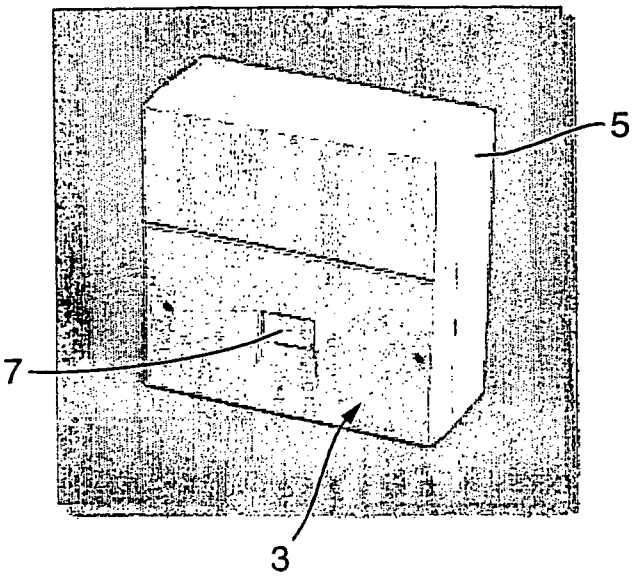
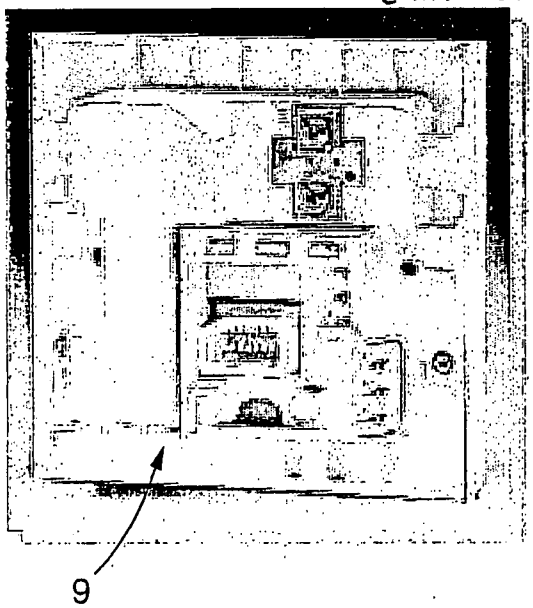


Fig. 1B
(PRIOR ART)



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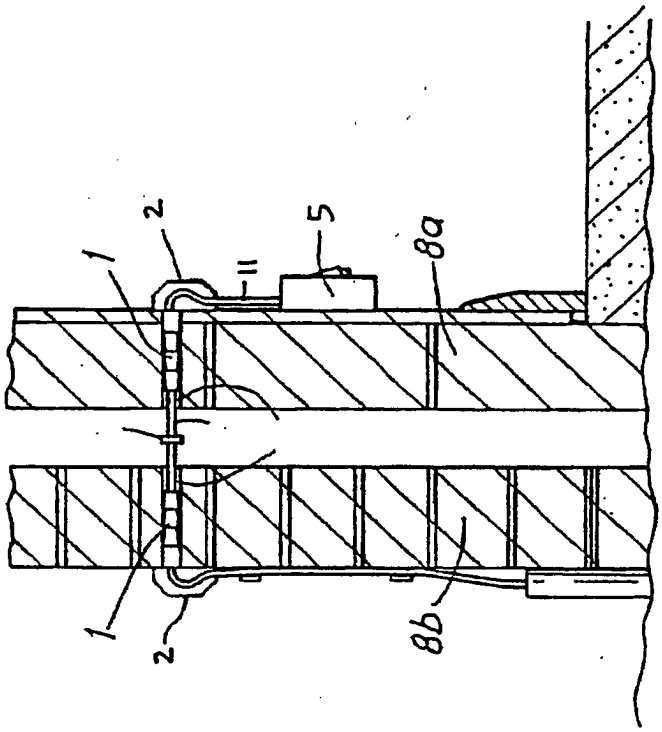

FIG. 2 - PRIOR ART
(PRIOR ART)

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Fig.3A.

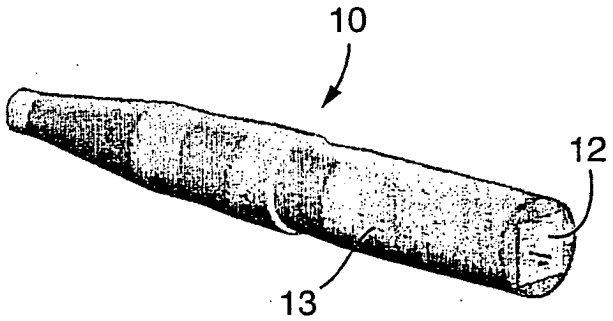

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Fig.3B.

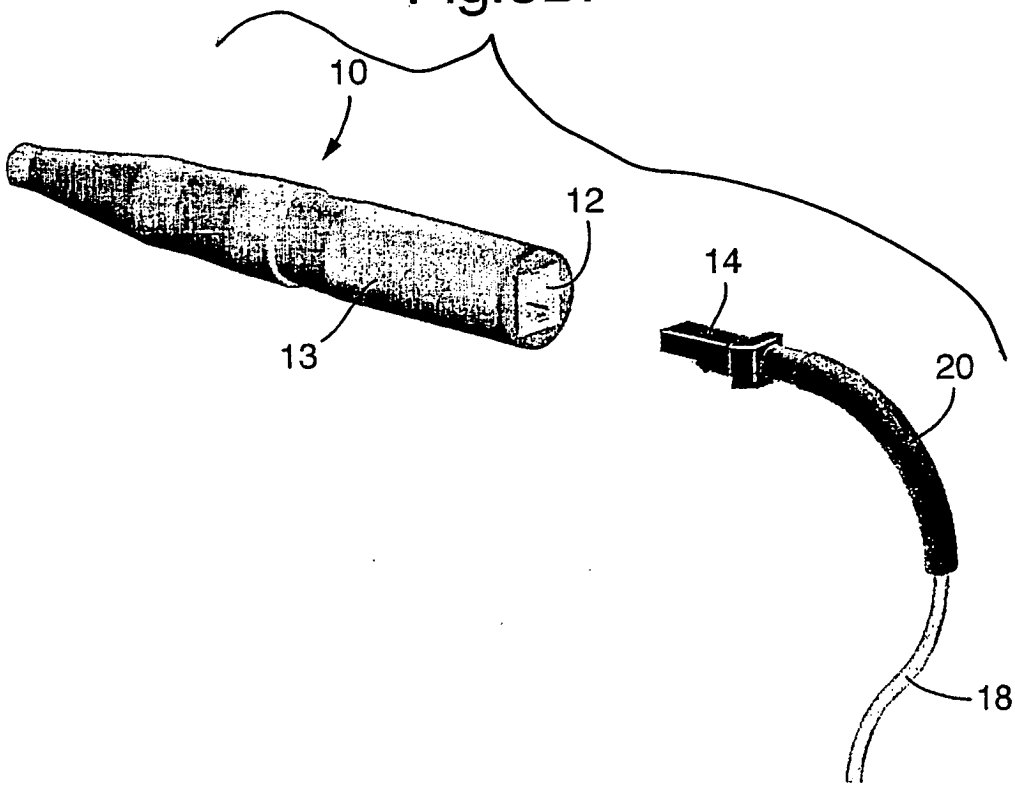

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Fig.4A.

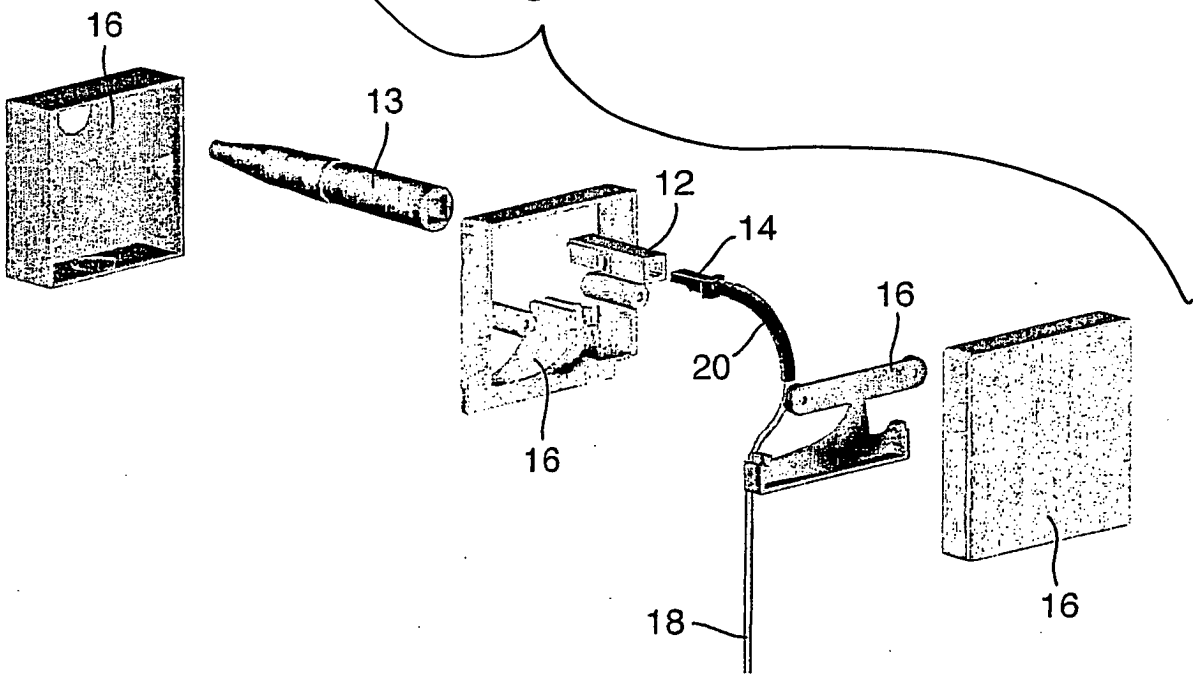

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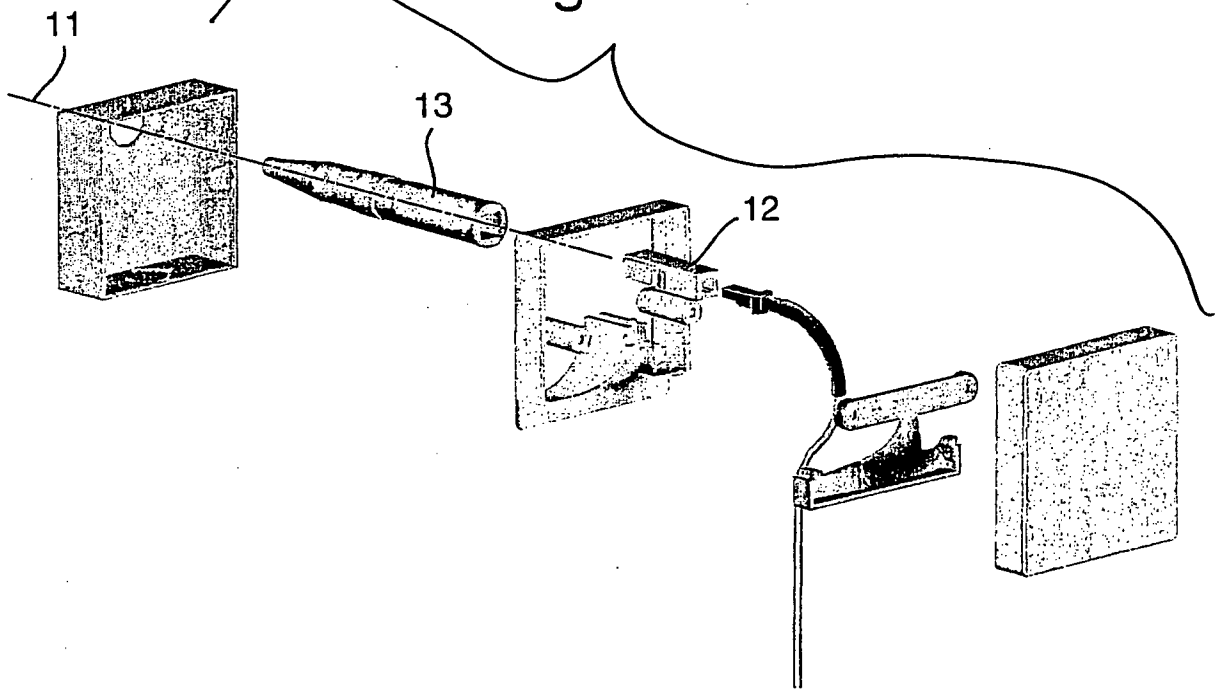
Fig.4B.



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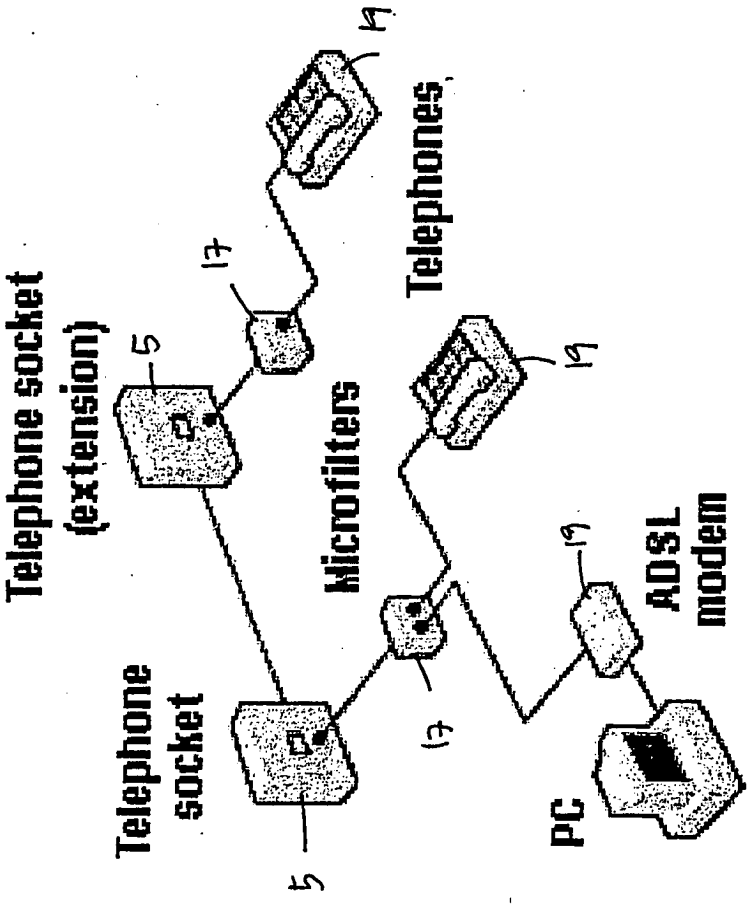

FIG. 5 (PRIOR ART)

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FIG. 6A

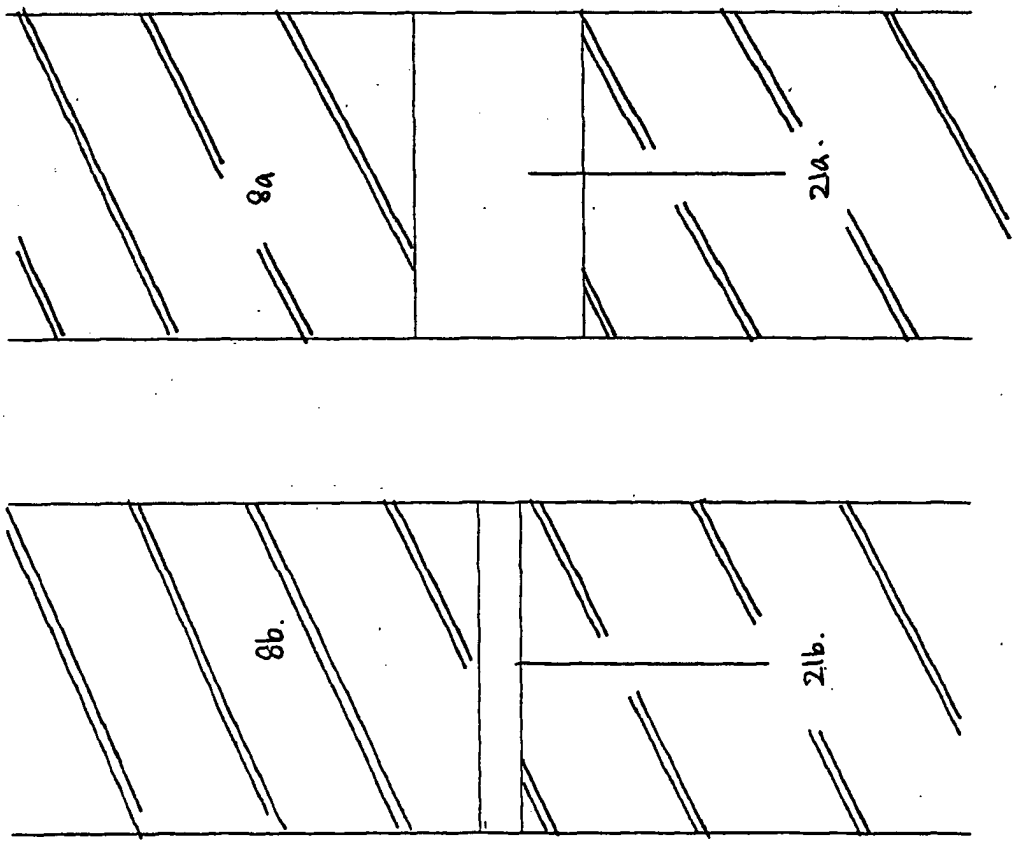

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FIG. 6B

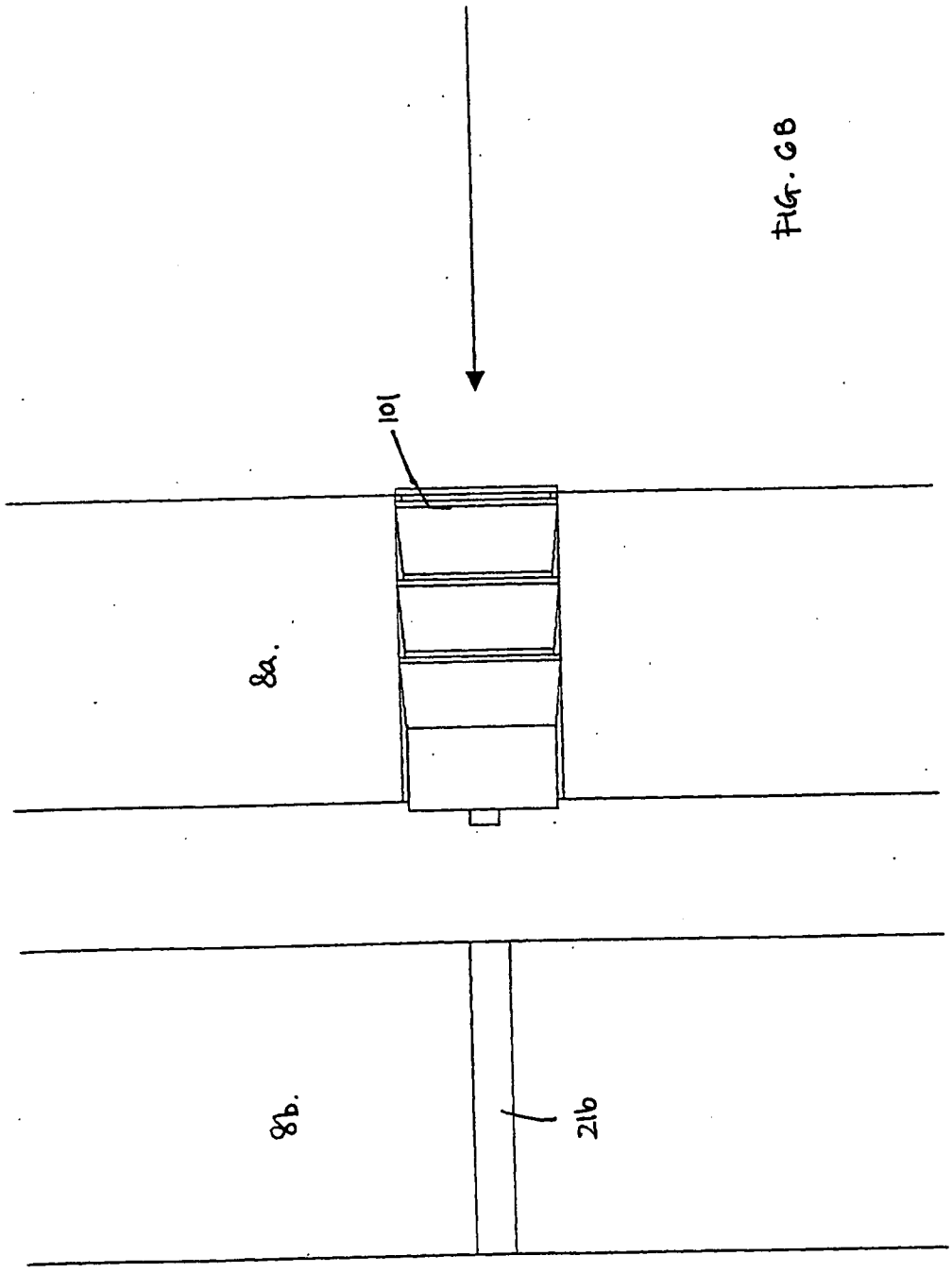

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Fig. 6C

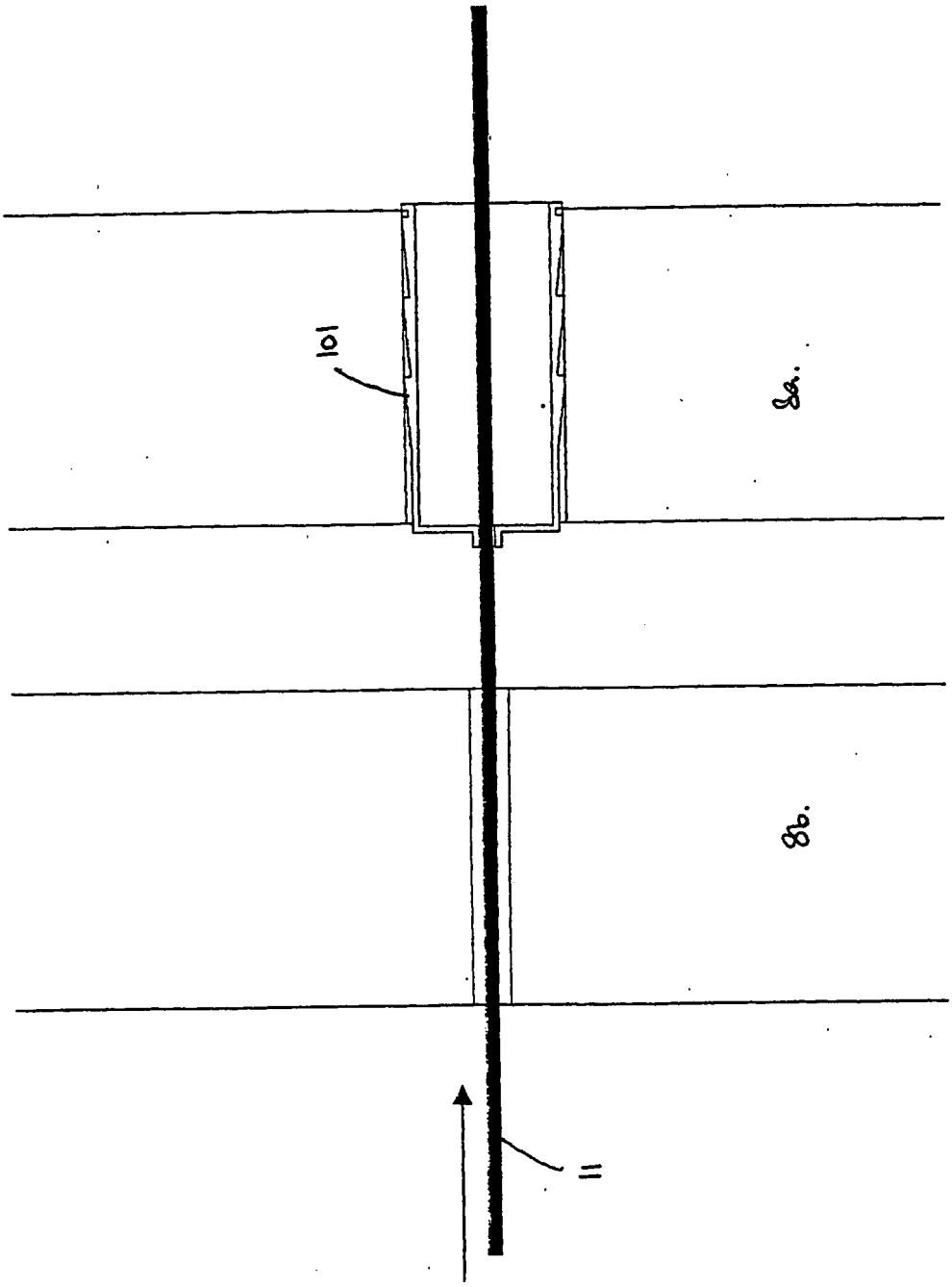

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FIG. 6D

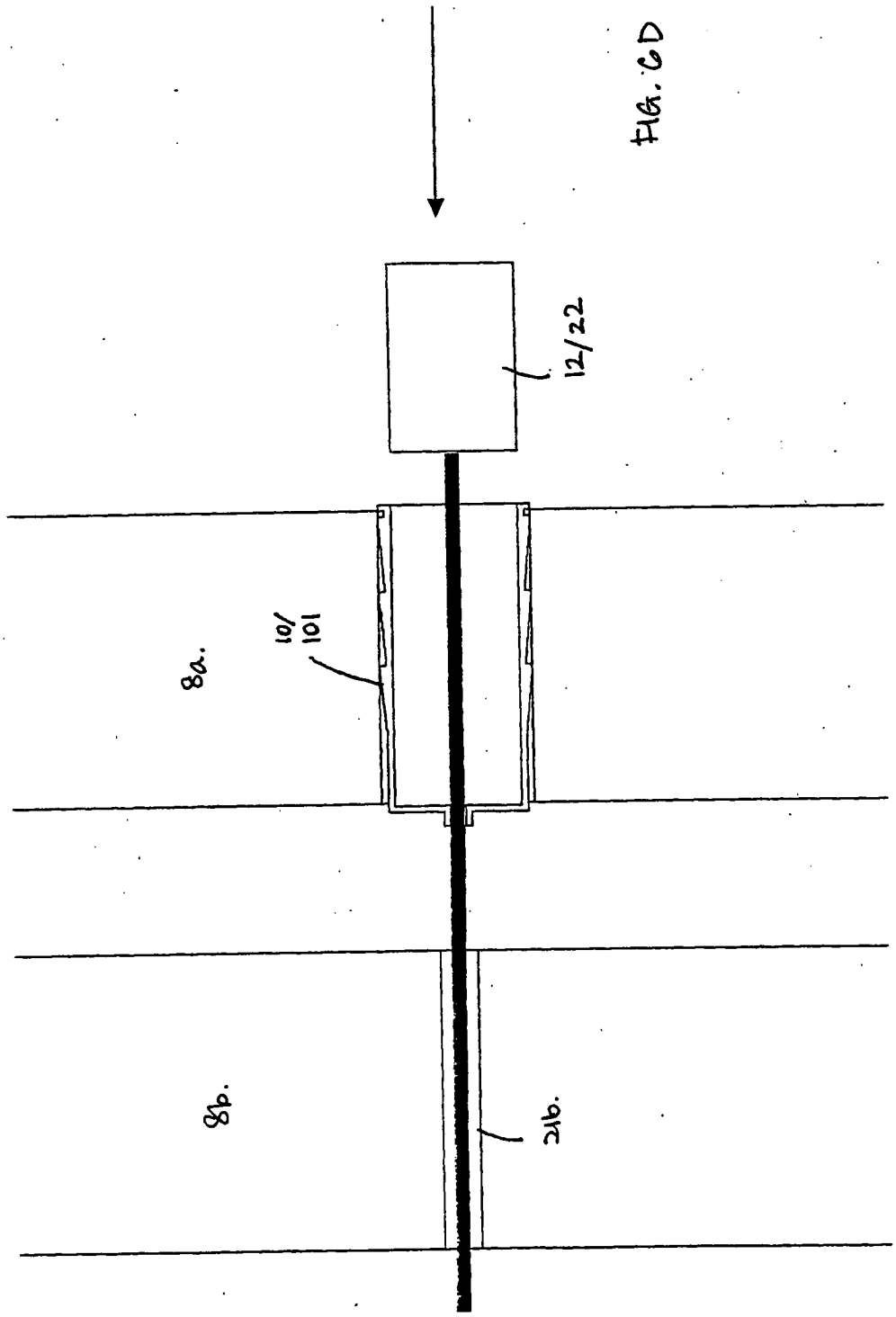

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FIG. 6E

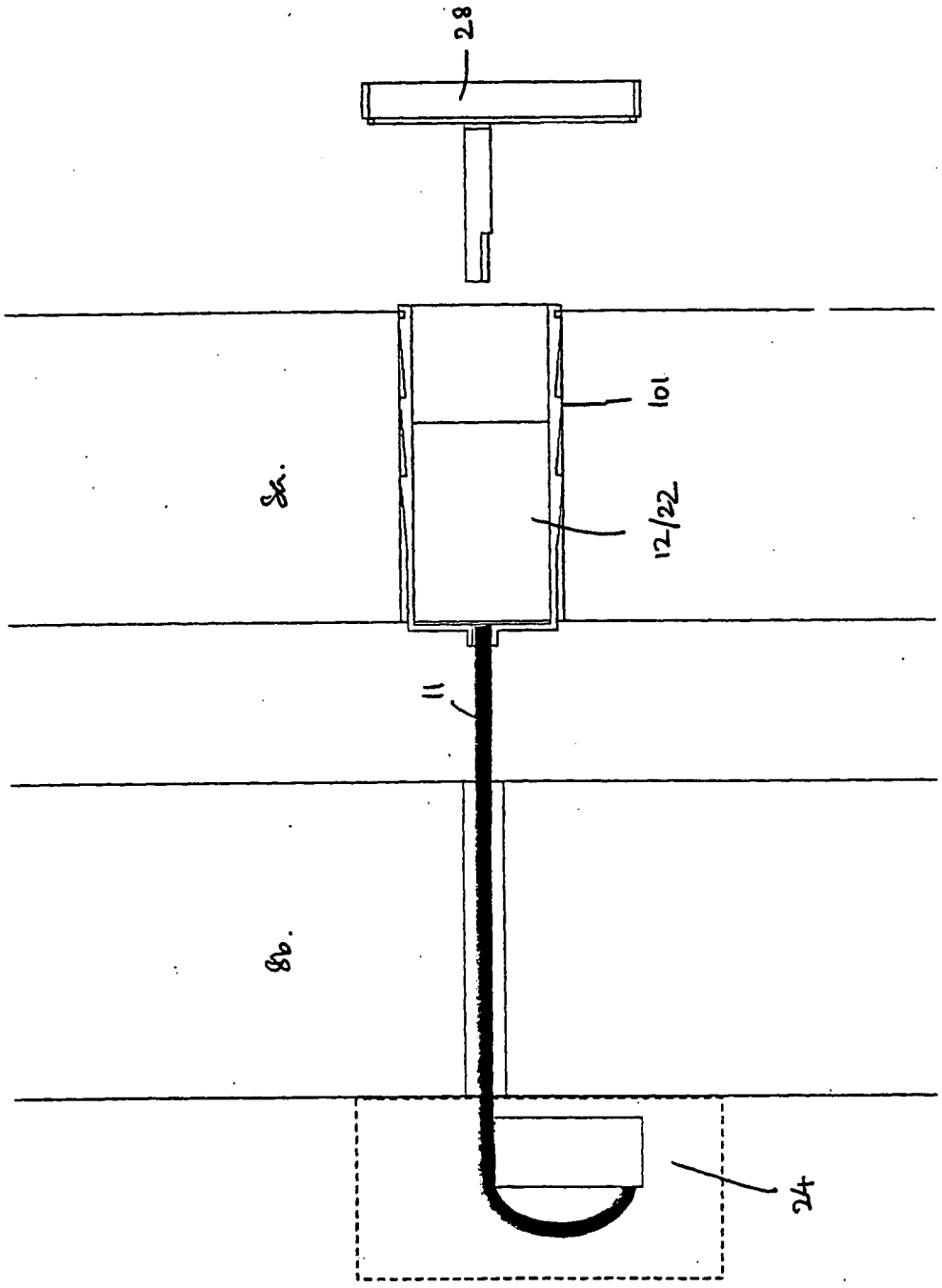

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FIG. 6F

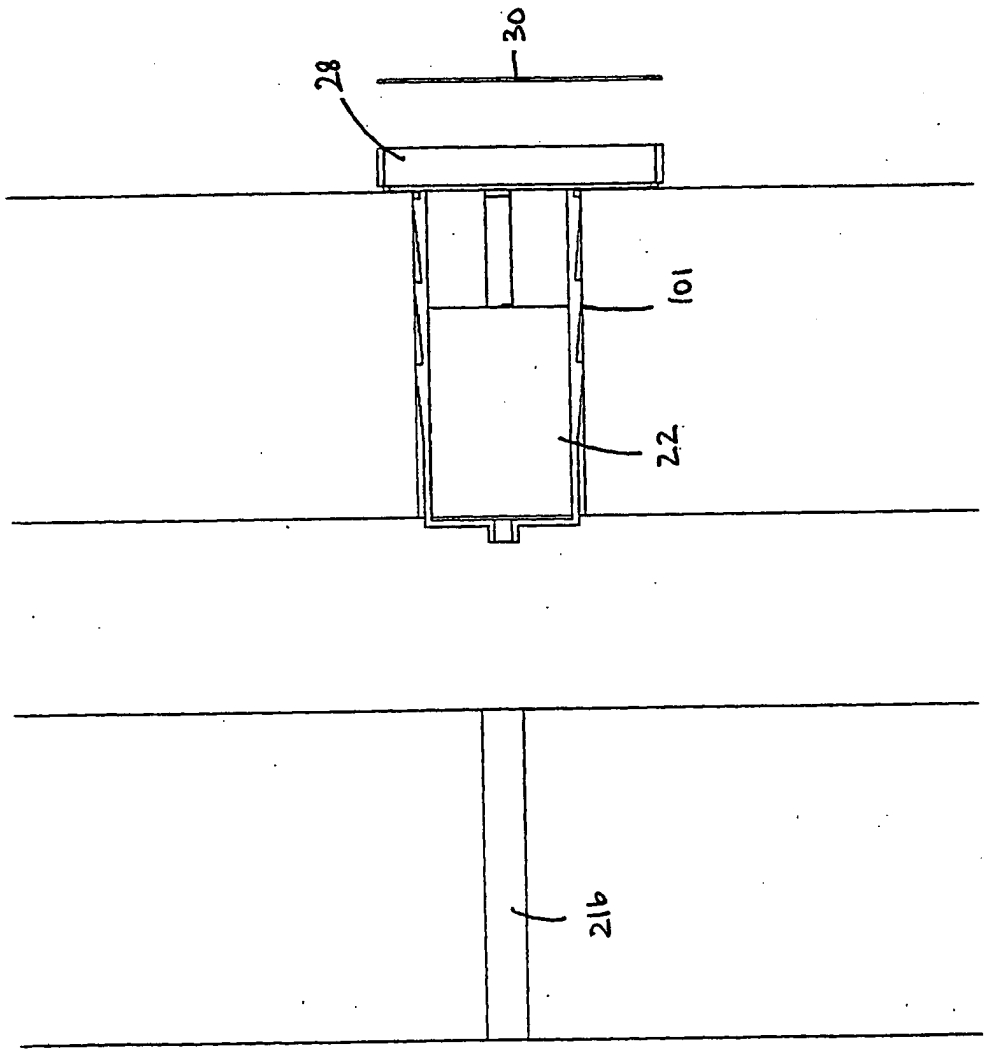

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FIG. 6G

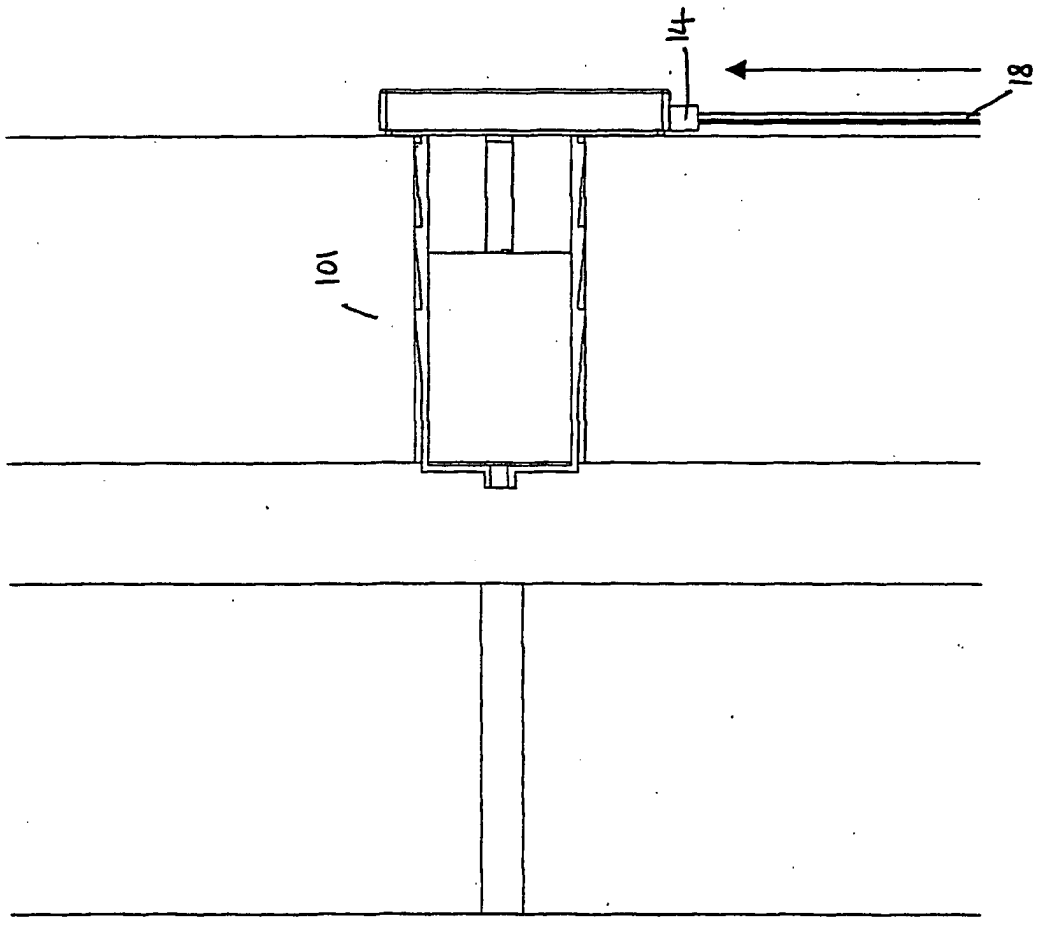

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FIG. 6H

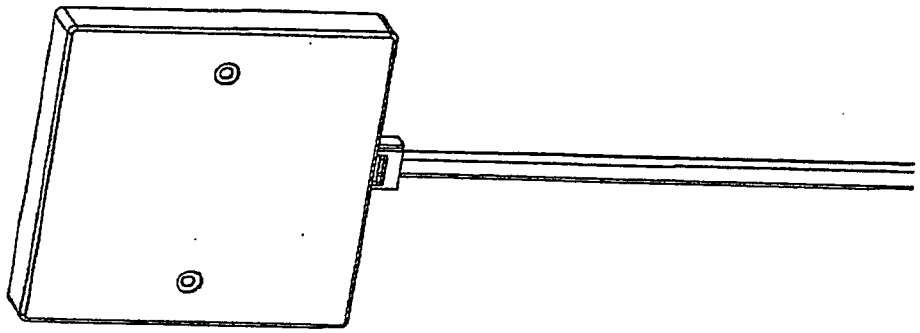

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Fig 7.